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Y-817

Subject Category: CHEMISTRY

UNITED STATES ATOMIC ENERGY COMMISSION

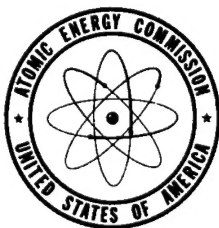
PRODUCTION OF ZIRCONIUM AT Y-12

By
J. W. Ramsey
W. K. Whitson, Jr.

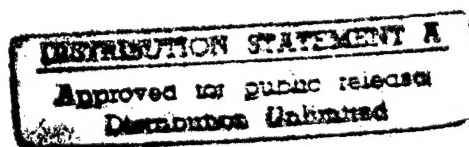
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October 12, 1951

Carbide and Carbon Chemicals Company
Oak Ridge, Tennessee



Technical Information Service, Oak Ridge, Tennessee



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Date Declassified: November 17, 1955.

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Printed in USA, Price 30 cents. Available from the Office of Technical Services, Department of Commerce, Washington 25, D. C.

Y-817

CARBIDE AND CARBON CHEMICALS COMPANY
A DIVISION OF UNION CARBIDE AND CARBON CORPORATION

Y-12 PLANT

W-7405-Eng-26

CHEMICAL DIVISION

Mr. J. M. Herndon, Superintendent

CHEMICAL DEPARTMENT

Mr. G. A. Strasser, Superintendent

PRODUCTION OF ZIRCONIUM AT Y-12

J. W. Ramsey
W. K. Whitson, Jr.

ABSTRACT

A general description is given of the permanent zirconium plant at Y-12. Equipment is described and materials of construction are listed. Photographs illustrating principal equipment and reduced construction drawings are also presented. Operating conditions and costs information are listed.

Oak Ridge, Tennessee

October 12, 1951

INTRODUCTION

Production of purified hafnium-free zirconium was begun at Y-12 in January, 1950. At the request of the Atomic Energy Commission, a quick installation of equipment was made in order to produce 25,000 pounds of zirconium as oxide for initial experiments for the Naval Reactor Program. Less than 0.1% contained hafnium was specified. At that time, a program was started on designing a more efficient plant for the production of 150,000-200,000 pounds of zirconium per year. The permanent zirconium plant was completed in October, 1951. Additions were made to the extraction facilities and equipment for continuous purification by the phthalate process and continuous drying and calcining were provided.

At the time of this writing, the permanent zirconium plant is in the start-up stage. This report describes the equipment and process as they now exist and the operational plans which have been developed from experience and from laboratory and pilot plant work.

The original proposal for the permanent zirconium plant is outlined in a report, Y-573, "Separation of Zirconium and Hafnium - Proposal for Construction and Operation of Zirconium Production Plant", J. M. Googin and G. A. Strasser, March 14, 1950. These plans have been followed to completion with but few changes. Greater length of extraction and stripping columns was installed than was first planned in order to effect more complete separation

which was later requested. Later information obtained on calcining showed that protection against contamination in this stage was more difficult than had been expected, and consequently the expense of more elaborate calcination equipment was required. Corrosion of exteriors from vapors in the processing areas was found to be a serious problem and more elaborate ventilation and protective measures were taken than had been planned in the proposal. Otherwise the original proposal has been followed through approximately as first outlined.

It is suggested that reference should be made to report Y-573 relative to studying the report presented here.

DESCRIPTION OF PROCESS

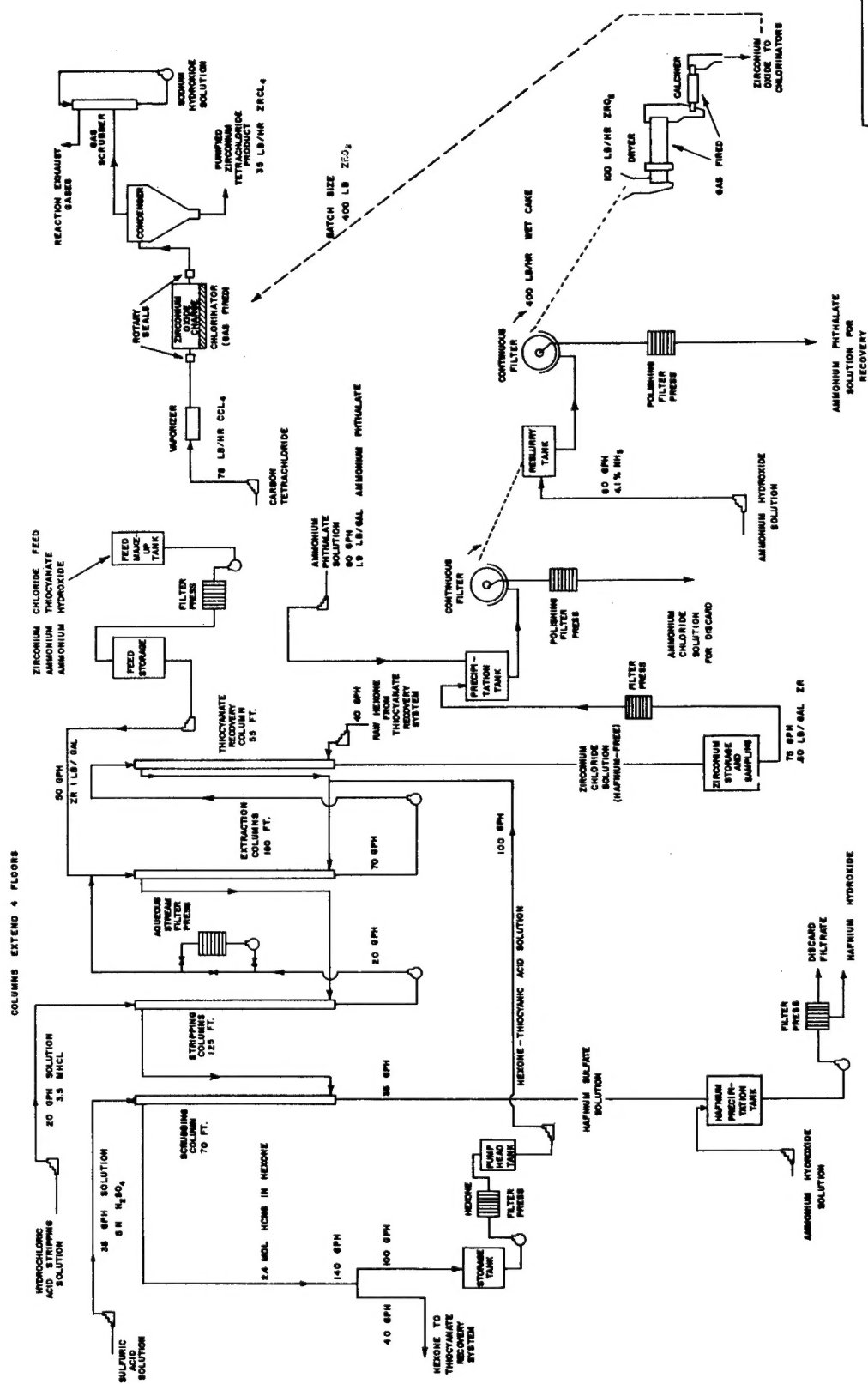
The attached flow sheet and photographs illustrate the permanent zirconium plant in Building 9211 at Y-12.

Zirconium tetrachloride, normally containing from 1.5 percent to 2.0 percent hafnium, is received from Titanium Alloy Manufacturing Division of the National Lead Company for use as feed material. Hafnium is removed from zirconium by an extraction process and resulting solutions are further purified by phthalate precipitation. Zirconium phthalate is converted to zirconium hydroxide by ammonium hydroxide leaching and the zirconium hydroxide is dried and calcined. The zirconium oxide is then chlorinated to form zirconium tetrachloride, which is used in magnesium reduction to the metal.

The steps in processing at Carbide and Carbon Chemicals Company, Y-12 Plant, are shown on the attached flow sheet and outlined as follows:

Hafnium Separation

Hafnium is separated from zirconium by a solvent extraction process employing methyl iso-butyl ketone. The separation is carried out in continuous counter-current spray towers. Solution containing normal zirconium is fed in the center of the extraction plant. The zirconium solution flows out the bottom of the plant while the hafnium is carried by the solvent to the top of the plant.



Zirconium tetrachloride is dissolved in water (top center of flow sheet) and the required quantities of ammonium thiocyanate and ammonium hydroxide are added to form the extraction feed solution. Some of the equipment used is shown in Figure 1, "Feed Make-up and Storage Area - Tank Pit". Feed solution is pumped to the column (Figure 2, "Base of Extraction Columns-First Floor"). There are three columns for extraction, two columns for stripping, one column for scrubbing, and one column for thiocyanate recovery. Columns are controlled by operators on the third floor (Figure 3, "Extraction Control Area").

Hafnium thiocyanate is preferentially extracted into hexone-thiocyanic acid solution, which is pumped into the bottom of the extraction column. Hexone from the extraction column flows into the stripping column, counter-current to a stripping solution of dilute hydrochloric acid. Aqueous stripper solution containing stripped zirconium is fed back into the extraction column with the extraction feed solution. Stripped hexone containing very pure hafnium flows into the scrubbing column where it is scrubbed with sulfuric acid solution. This hexone, free of metal, but still containing thiocyanic acid is recirculated to the extraction columns.

For smallest useage of thiocyanate, it is desirable to have thiocyanate concentration in the product stream at a very low level. This is accomplished

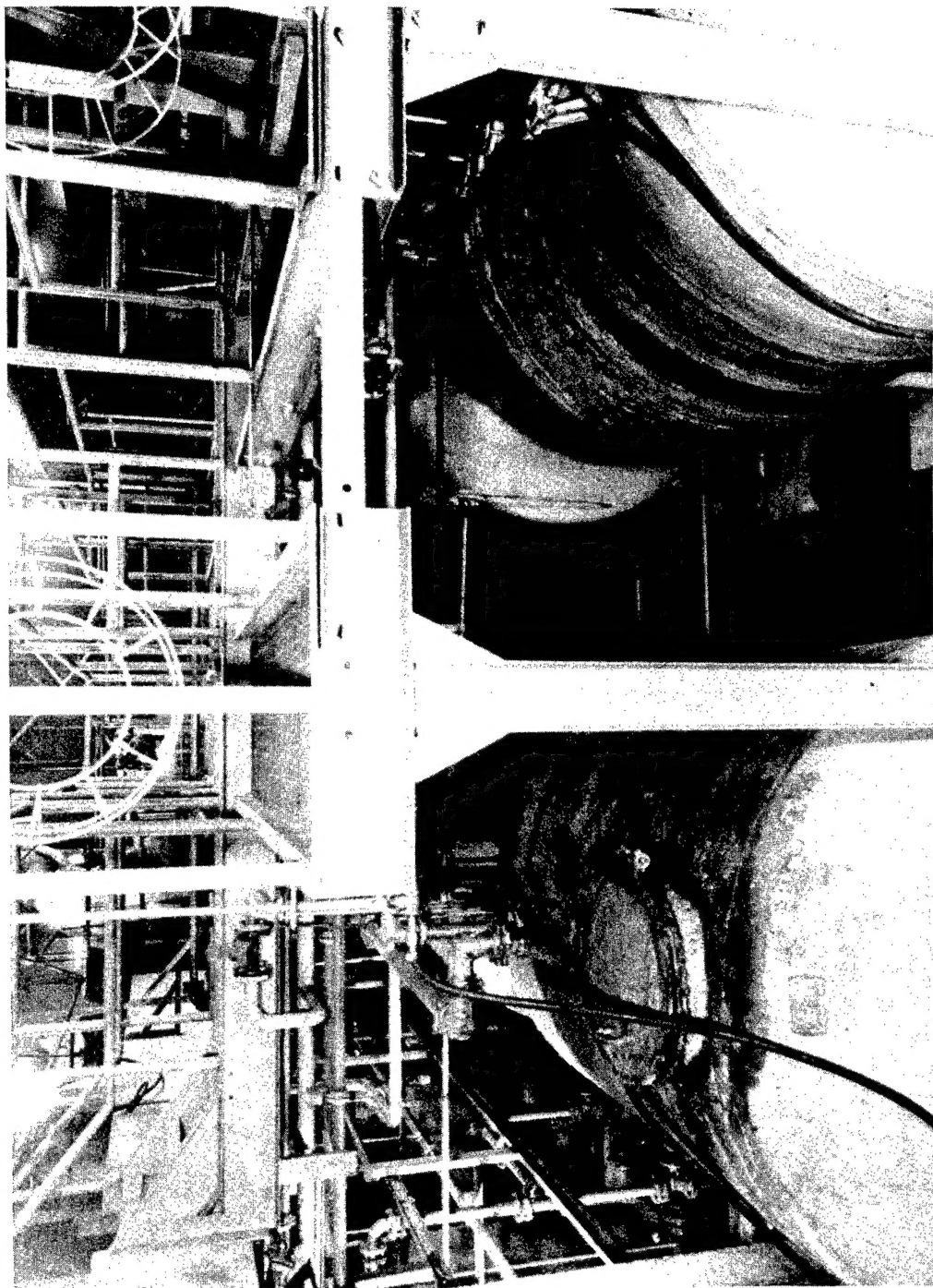


FIGURE 1. FEED MAKEUP AND STORAGE AREA - TANK PIT

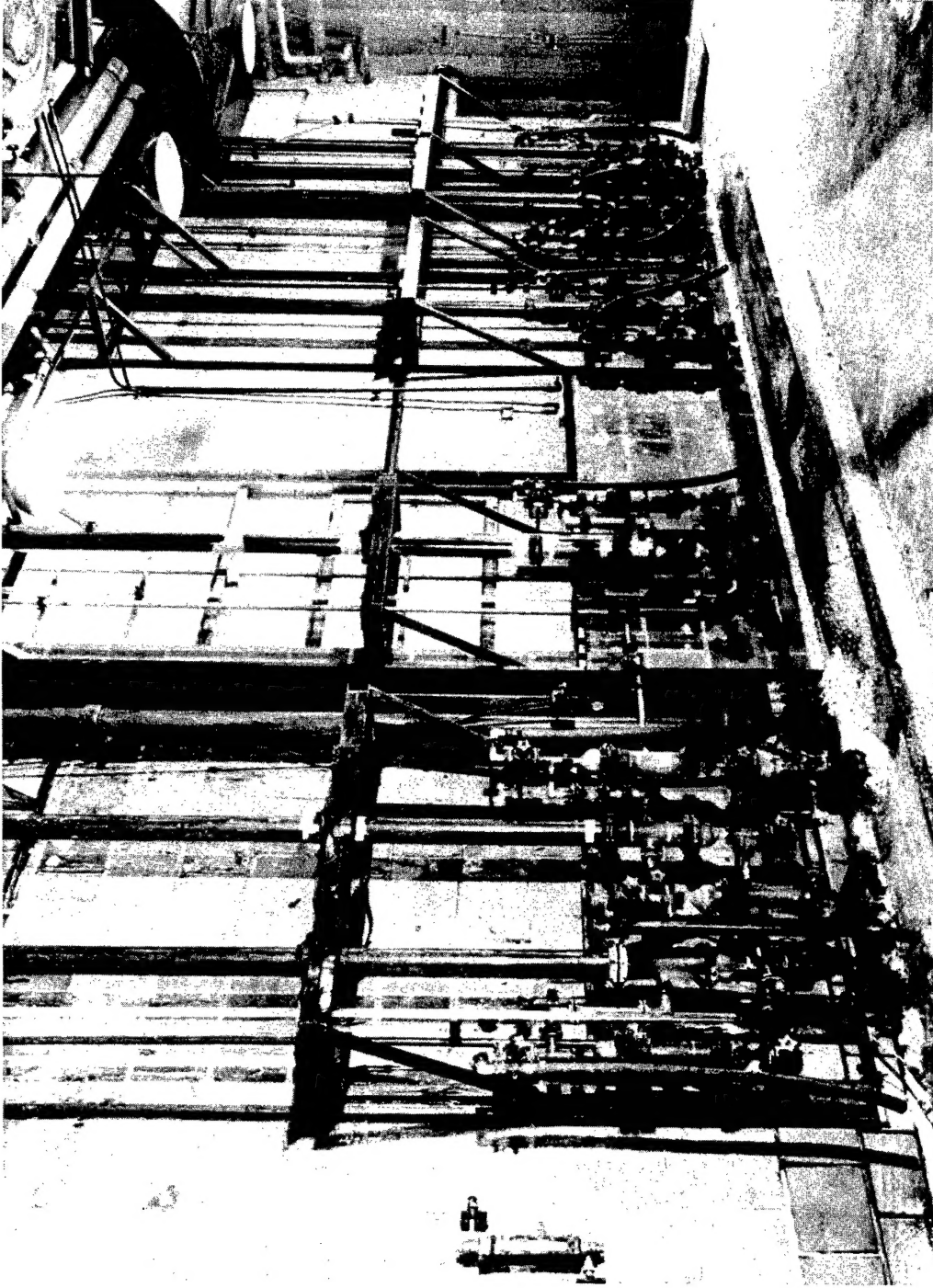


FIGURE 2. BASE OF EXTRACTION COLUMNS -- FIRST FLOOR

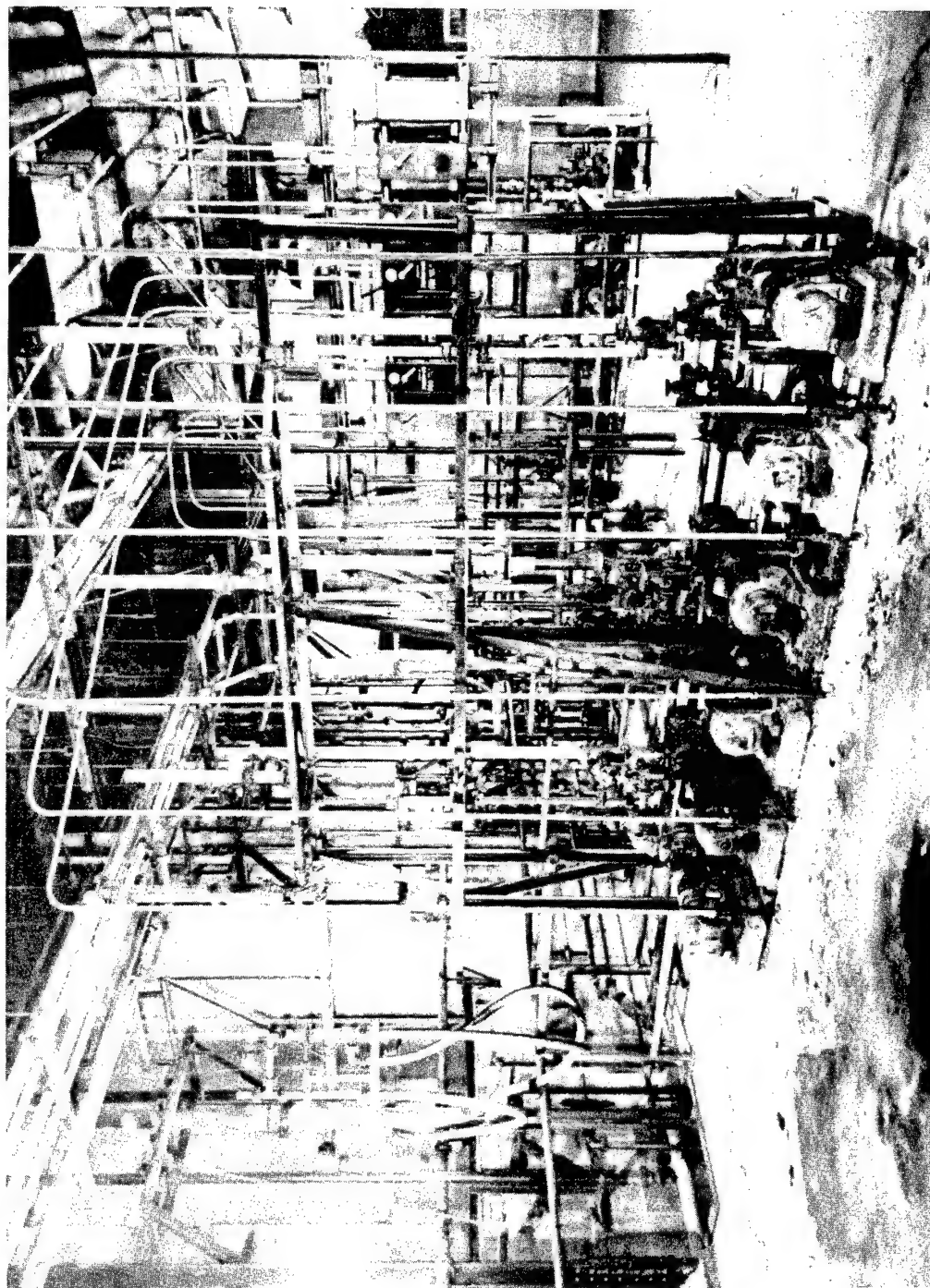


FIGURE 3. EXTRACTION CONTROL AREA - THIRD FLOOR

by directing the aqueous solution from the third extraction column into a thiocyanate recovery column. The thiocyanate recovery column is fed with raw hexone at a rate of approximately one-third the total hexone flow. Hexone from this column contains thiocyanic acid at the proper concentration for extraction and is mixed with the hexone entering the extraction columns. Raw hexone to be fed to the thiocyanate recovery column is prepared from a portion of the scrubbed hexone diverted to an ammonium neutralization system. Ammonium thiocyanate from this system is used in feed makeup.

Zirconyl chloride solution, hafnium-free, goes from the last extraction column to a tank for storage and sampling, and then to be further processed by precipitation with ammonium phthalate solution.

The hafnium is recovered from the hexone by sulfuric acid scrubbing. Hafnium is recovered from the sulfuric acid solution as hafnium hydroxide by precipitation with ammonium hydroxide.

Separation of Other Impurities

While hafnium is the element requiring special separation procedures, it is also necessary to remove other metal ions present as impurities in the feed material. This purification is carried out by precipitating zirconium as zirconyl phthalate. The phthalate precipitation is very selective for zir-

conium and hafnium, while other impurities, such as iron, copper, cadmium, etc., remain in solution and are thus separated.

In the permanent zirconium plant, ammonium phthalate solution and zirconium chloride solution are fed continuously to a precipitation tank, which, in turn, feeds a continuous Eimco filter. This equipment is shown in Figure 4, "Phthalate Precipitation Equipment and Filters." Cake is scraped continuously from the filter and reslurried with ammonium hydroxide solution. This slurry is filtered on a continuous Oliver filter. The ammonium phthalate solution from the filter is recovered by evaporation. (Figure 5, "Ammonium Phthalate Evaporator").

Zirconium hydroxide cake from the Oliver filter falls from the filter scraper blade through a chute into a continuous gas-fired drier, manufactured by the Bartlett-Snow Company. This is shown in Figure 6, "Assembly Work on Drier - Third Floor." The dried zirconium hydroxide falls continuously into silica-lined calciners in which it is converted to high purity zirconium oxide, (Figure 7, "Calcliner - Second Floor"). Calciners were also manufactured by the Bartlett-Snow Company, and liners are supplied by the Amersil Company and the General Ceramics Company.

Hafnium hydroxide is redissolved and purified by the same chemical process

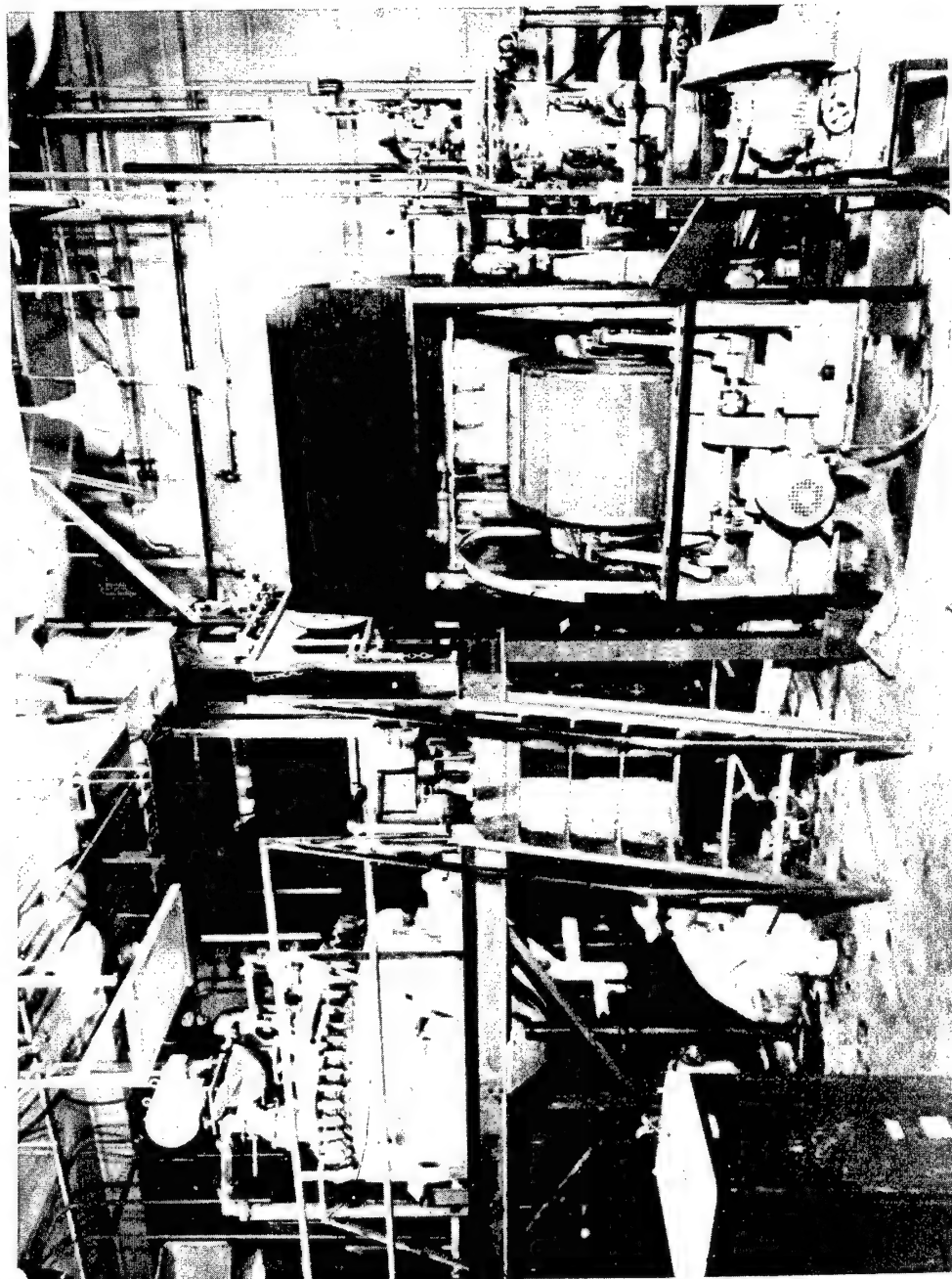


FIGURE 4. PHTHALATE PRECIPITATION EQUIPMENT AND FILTERS -
FOURTH FLOOR

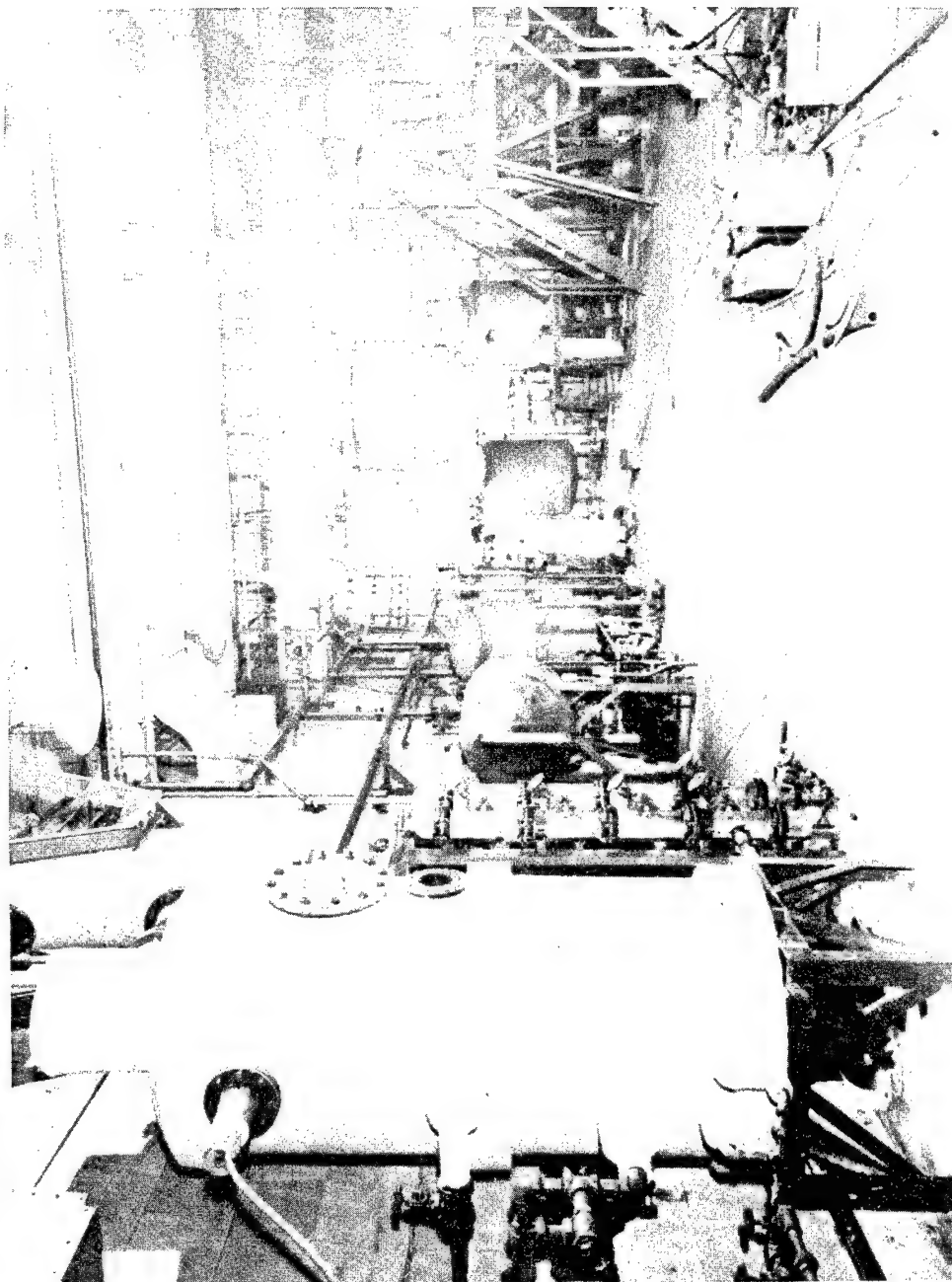


FIGURE 5. AMMONIUM PHTHALATE EVAPORATOR, MISCELLANEOUS HEAD
TANKS IN BACKGROUND - FOURTH FLOOR

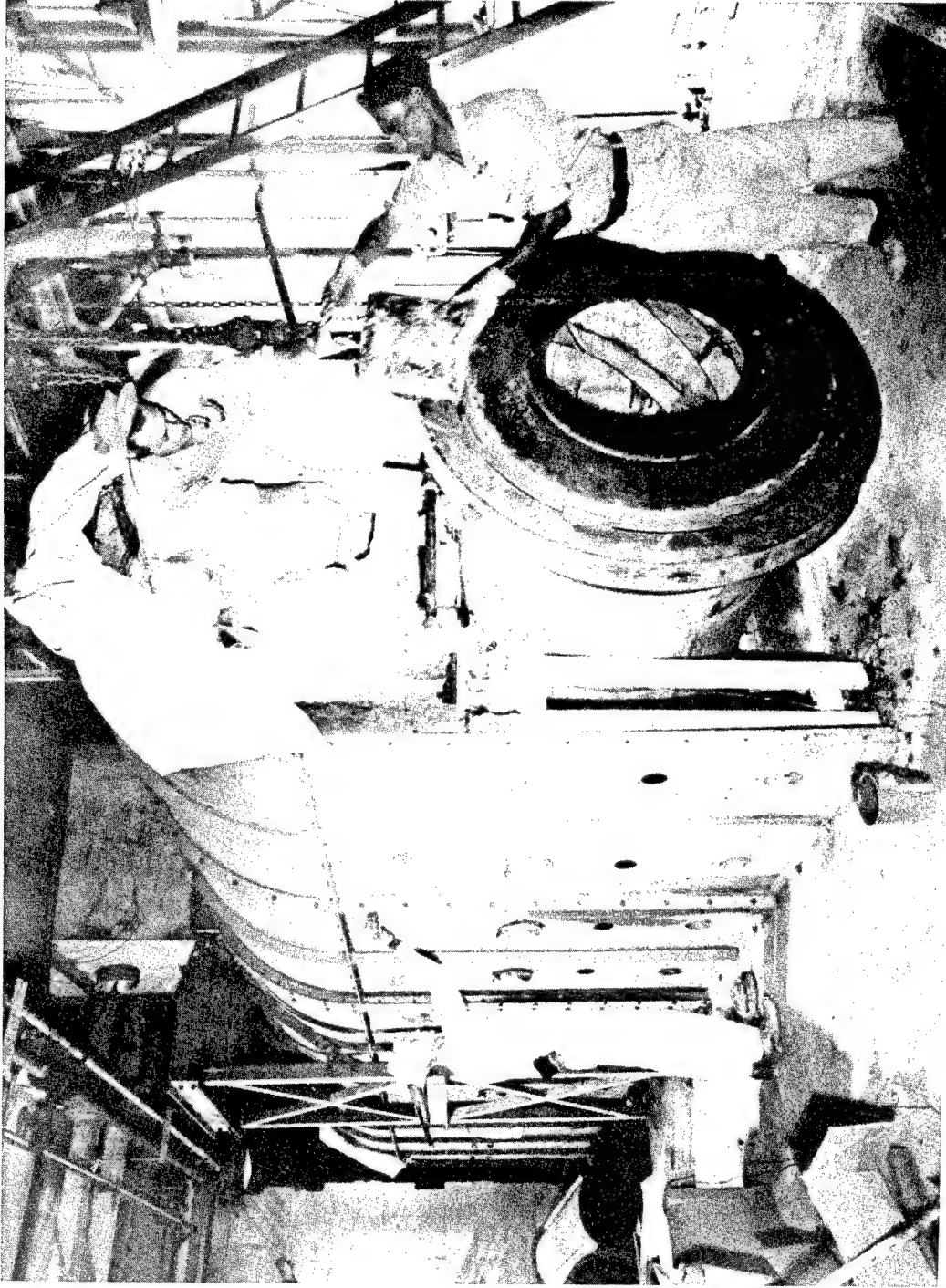


FIGURE 6. ASSEMBLY WORK ON DRIER - THIRD FLOOR

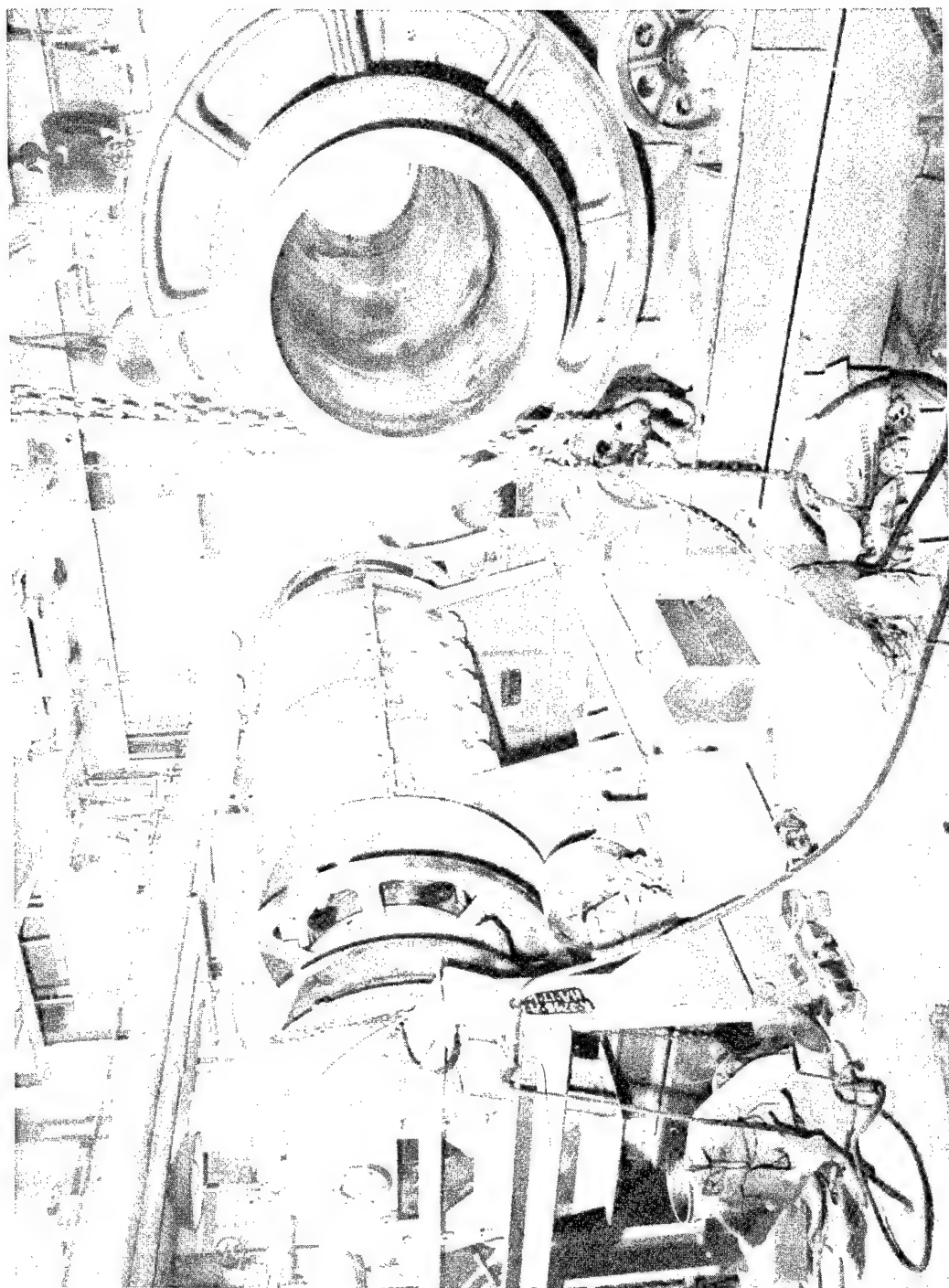


FIGURE 7. CALCINERS - SECOND FLOOR.

used for zirconium hydroxide. Some of the equipment in which this work is carried out may be seen in Figure 8, "Hafnium Purification Equipment."

Chlorination

The method of chlorination that was used at Y-12 consisted of direct chlorination of the oxide with carbon tetrachloride in a rotary horizontal reactor. Zirconium oxide was charged batchwise into the reactor. Carbon tetrachloride was fed through a vaporizer into the rotary reactor forming volatile zirconium tetrachloride. The zirconium tetrachloride gas was collected in an air-cooled condenser and cleaned batchwise into shipping containers. The reaction gases were scrubbed in a sodium hydroxide system, (Figure 9, "Control Panel and Condensers of Horizontal Chlorinators - First Floor").

MATERIALS OF CONSTRUCTION

Handling of Process Materials

General selection of materials of construction at various stages of processing is given in Table I, "Materials of Construction for Handling of Process Materials". This table gives the actual construction of the permanent zirconium plant. Selection has been made based on chemical resistance to process solutions of various materials, and availability of standby equipment at Y-12.

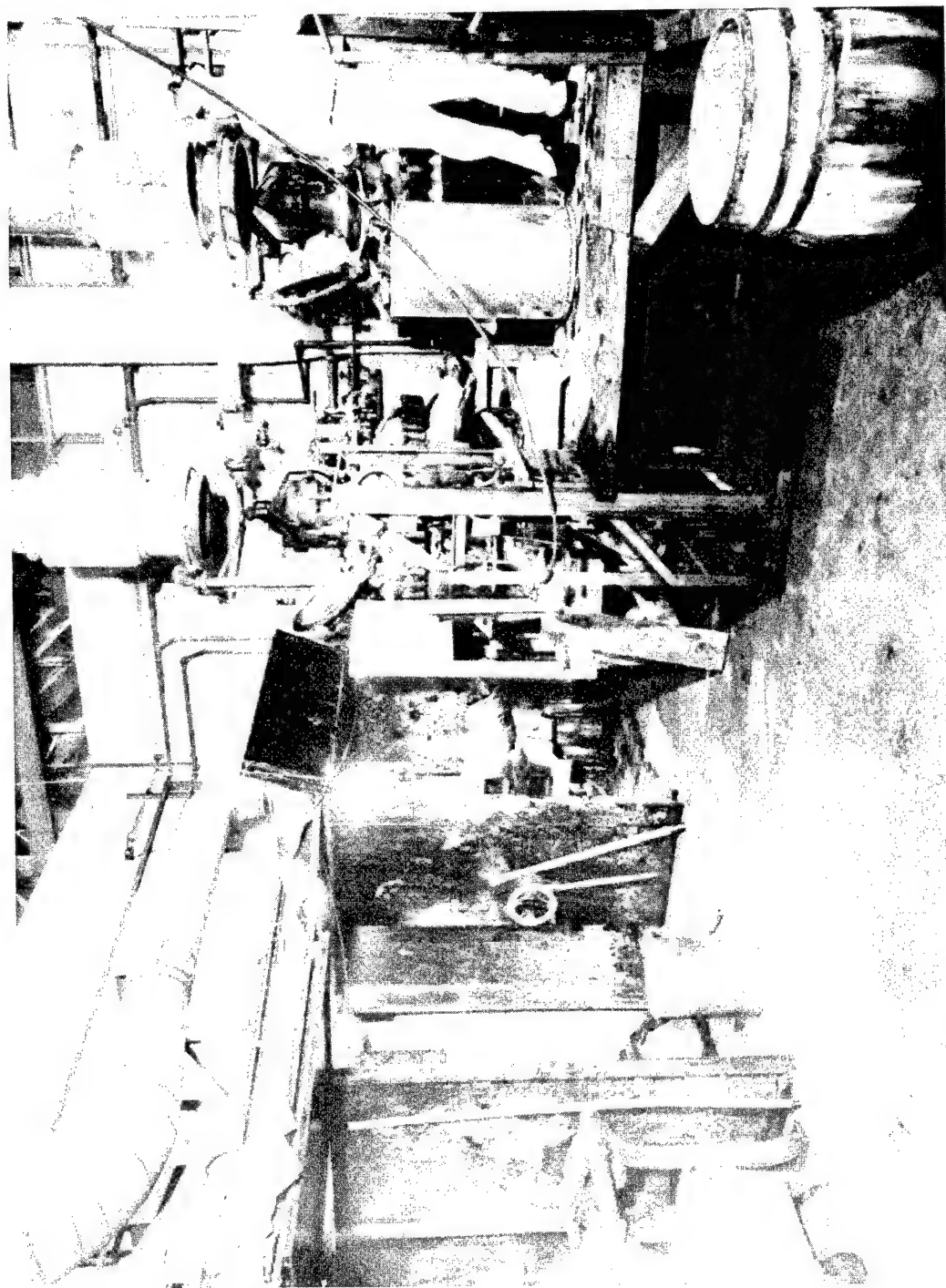


FIGURE 8. HAFNIUM PURIFICATION EQUIPMENT

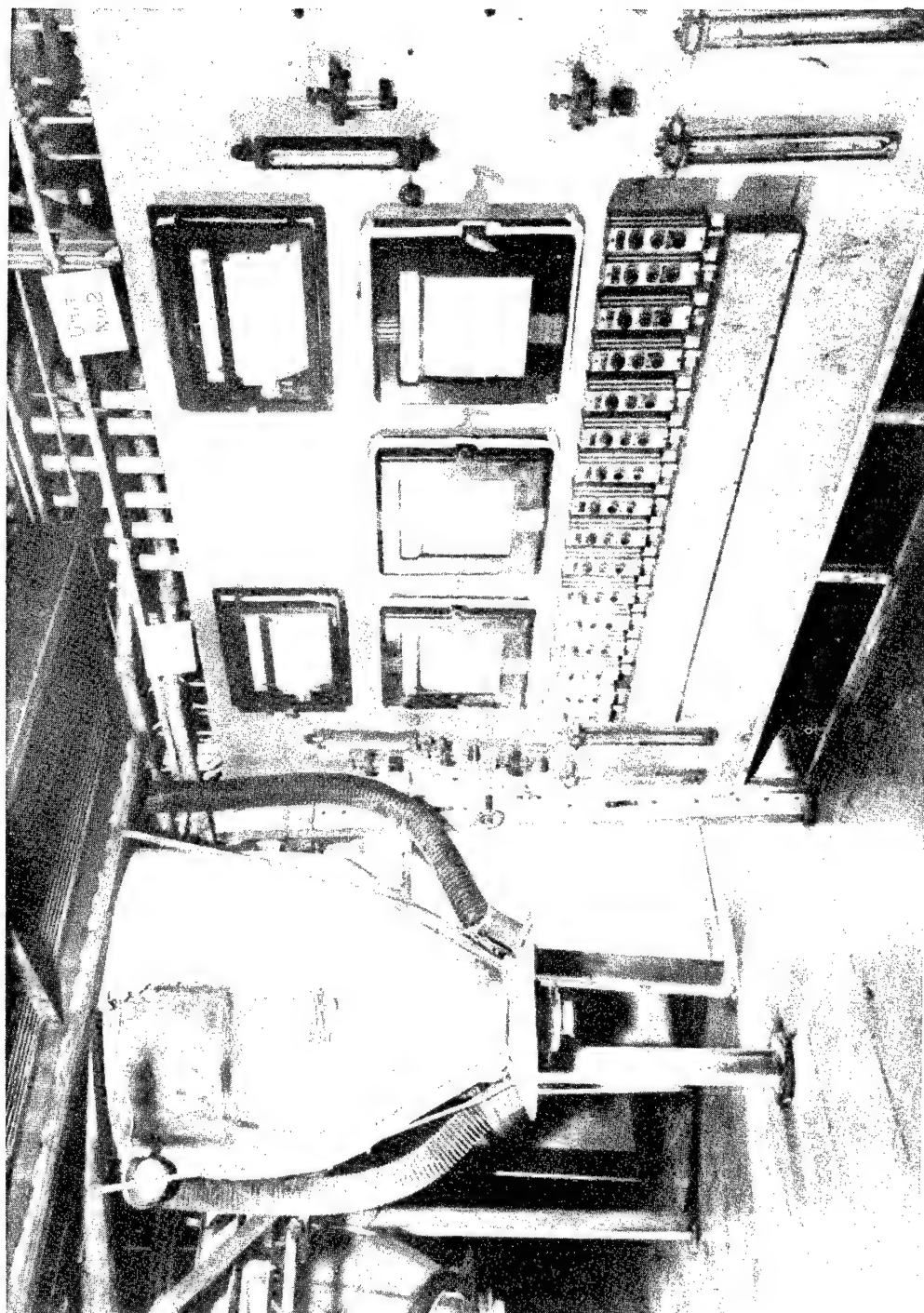


FIGURE 9. CONTROL PANEL AND CONDENSERS OF
HORIZONTAL CHLORINATORS -FIRST FLOOR

TABLE I
MATERIALS OF CONSTRUCTION FOR HANDLING OF PROCESS MATERIALS

EXTRACTION	Tanks and Equipment	Pipe	Valves	Diaphragms	Pumps	Gaskets	Packing	Pump Lubrication
Aqueous Extraction Solution, and Stripping Solution (0.2-0.5 mol HCl)	Glass-lined, Rubber-lined	Glass	Glass-lined	Tygon, Neoprene	Durchlor, Hastelloy C	Koro-seal, Neoprene	Teflon, Durco 400-B	Nordco-seal 755-S Rockwell Mfg. Co., Pittsburgh
Hexone (Acid)	Glass-lined, Stoneware	Glass	Glass-lined	Neoprene	Durchlor, Hastelloy C	Neoprene	Teflon, Durco 400-B	Nordco-seal 755-S
Hexone (Neutral)*	Glass-lined, Stoneware	Glass	Glass-lined	Butyl Rubber Neoprene	-	Butyl Rubber, Neoprene	Teflon, Durco 400-B	Nordco-seal 755-S
Sulfuric Acid (5 Mol)	Glass-lined	Glass	Glass-lined	Tygon	-	Koro-seal	Teflon	Nordco-seal 755-S
Sulfuric Acid (Conc.)	Black Iron	Black Iron, Glass	Black Iron	-	Black Iron, Carpenter 20 SS	-	Teflon	Nordco-seal 755-S
Conc. HCl (for Stripper Makeup)	Glass-lined	Glass	Glass-lined	Tygon	Haveg	Koro-seal	Teflon	Nordco-seal 755-S
PURIFICATION								
Extraction Effluent	Glass-lined, Wood, Hastelloy C, Rubber-lined	Glass, Hard Rubber	Glass-lined, Rubber-lined	Tygon	Durchlor, Hastelloy C	Koro-seal	Teflon	Nordco-seal 755-S
Ammonium Phthalate Solution	SS 316	SS 316	SS 316	-	SS 316, Black Iron	Koro-seal	Asbestos	Nordco-seal 755-S
Drying (to 300°C)	SS 316							Nordco-seal 755-S
Calcining (to 700°C)	Fused Quartz							Nordco-seal 755-S
CHLORINATION								
CCl ₄	SS 316	Black Iron	Black Iron		Black Iron	-	Asbestos	Nordco-seal 755-S
ZrCl ₄ Gas (above 350° C)	Carbon, Quartz							
ZrCl ₄ Solid (below 350° C)	Nickel							

* Protection against acid is made since possibility of acid condition exists in most cases. Pure hexone is a good organic solvent but is not corrosive.

Background for selection is given in a report, Y-589, "Corrosion Study for a Chemical Processing Plant", Frank A. Knox, August, 1950.

In general it is found that HCNS in hexone is corrosive to about the same extent as HCl. Metals which can be used to resist this combination are Hastelloy C and Durchlor. Various rubber-like materials may be used for gasket material, although hexone is a solvent for many gasket and diaphragm materials. Butyl rubber and Neoprene appear to be the most satisfactory for resistance to neutral hexone. A large amount of process piping is standard Pyrex glass with flange fittings; this gives resistance to most of the process solutions and also provides visibility.

For resistance to sulfuric acid, glass has been used for dilute solutions. Concentrated sulfuric acid is handled in black iron, and carpenter 20 stainless steel is used as piston material in a metering pump where the piston is alternately exposed to sulfuric acid and the atmosphere.

Concentrated hydrochloric acid is handled in glass-lined tanks and glass piping. A Haveg metering pump is used for metering concentrated hydrochloric acid. Chemical resistance is good, although mechanical properties are not as satisfactory as desired.

In the phthalate purification step, an acid-resistant filter of wood is being

used. It is indicated at this time that a totally rubber-covered steel filter might be more suitable. Filter media for hydrochloric acid solutions is high temperature Vinyon or Dynell. Particle size is small and a tight weave is required.

The dryer is constructed of 316 stainless steel, which has been shown in the laboratory to be satisfactory up to 300 degrees Centigrade from the corrosion standpoint. Extensive tests on metals for calcining zirconium oxide failed to show a satisfactory metal. A fused quartz lined calciner was developed for this application in conjunction with the Bartlett-Snow Company, the Amersil Company, and the General Ceramics Company. Efficiency of this equipment will be shown by operation.

Materials of construction for zirconium chlorination are limited for zirconium tetrachloride in the gas phase. Fused quartz has been found to be resistant at very high temperatures. Carbon is good in the range of 350 to 650 degrees Centigrade. Nickel is good at 350 degrees Centigrade and below, and is fairly satisfactory up to 550 degrees Centigrade, although it gives some contamination in this range.

General Protection Against Corrosion

Operation of the temporary zirconium plant showed that a severe corrosion

problem can result from vapors of process solutions in the extraction and purification plants. However, general corrosion can be controlled by taking proper protective measures.

Structural supports for extraction columns are fabricated from 316 stainless steel angle and non-reusable stainless steel pipe. This stands up with only surface discoloration under the conditions present, that is, spills of dilute hydrochloric acid and vapors of HCl under oxidizing conditions.

Filters are completely enclosed and ventilated. Hoods for filters are constructed of 1/2 inch marine plywood and coated with one coat of Penkote protective coating.¹ Glass pipe flanges on the columns are cast iron coated with seven layers of a baked phenolic resin coating.² Nuts and bolts on flanges of columns are of stainless steel 316.

Duct work for feed makeup exhaust system is fabricated of 316 stainless steel coated with baked on Heresite. Duct work for exhaust on filter hoods is fabricated from mild steel coated with baked Heresite.

¹Penkote 500, Peninsular Chemical Product Company, Van Dyke, Mich.

²Heresite P403, Heresite Chemical Company, Manitowoc, Wis.

PROCESS CONDITIONS AND EFFICIENCY

Extraction

Present operating conditions for the extraction columns are outlined as follows:

Length of Columns (Total)

Extraction	180 Ft.
Stripping	125 Ft.
Scrubbing	65 Ft.
Thiocyanate Recovery	55 Ft.
Hexone Rate	140 GPH
CNS Concentration in Recycle Hexone	2.7 Molar
HCl Rate, Stripping Section	18-20 GPH
HCl Concentration	3.5 Molar
CNS, Concentration In	0.0 Molar
CNS, Concentration Out	2.5-3.0 Molar
Feed Rate, Zirconium Oxychloride Solution	50 GPH
HCl Concentration	1 Molar
HCNS Concentration	2.6 Molar
Zr Concentration	1 #/gal.
H ₂ SO ₄ Rate, Scrubber Solution	35 GPH
H ₂ SO ₄ Concentration	5 Normal
CNS Conc., Feed to Thiocyanate Recovery Column	1.60 Molar
CNS Conc., Discharge from Thiocyanate Recovery Column	0.1 Molar
CNS Conc., Hexone to Column	0.0 Molar
CNS Conc., Hexone from Column	2.50 Molar
Rate of Hexone to Thiocyanate Recovery Column	40 GPH
Rate of Aqueous Solution in Column	70 GPH
Conc. Hf in Raw Feed	1.5-2.0 %
Conc. Hf in Product Zr	<100 PPM
Conc. Zr in Product Hf	Approximately 2 %

Yield of Zr Product Based on Feed Solution

96%

Percent Recycle of Hexone

96.5-97.0 %

Percent Loss of Hexone

3-3.5 %

Amount Makeup Hexone

90 Gals/day

	Optimum for Extraction Section	Optimum for Stripping Section
Distribution Coefficient Hf Org/Aq	1.5	0.7
Distribution Coefficient Zr Org/Aq	0.3	0.15
Separation Factor	4-5	4-5

Operation of the extraction units is carried out to achieve the best balance between product purity and yield of zirconium. Increased purity of zirconium can be obtained at the expense of yield and Hf purity. With the present method of operation it is possible to obtain a yield of better than 96% of Zr containing less than 100 ppm Hf while obtaining hafnium product containing between 0.5% and 3.0% Zr.

Purification

Efficiency of the purification plant has not yet been established, and it is expected that considerable process improvement work will be required to obtain maximum efficiency. It is expected that 98 % yield of zirconium will be obtained and that product purity will be equal to, or better than, purity of product

from the initial installation based on batch operation.

Phthalate recovery is expected to be about 80 percent. Recovery efficiency is very dependent on filter operation and wash distribution on the filter.

Recycle of ammonium hydroxide from the evaporator may be a practical step for economy. It is planned to add fractionating and condensing equipment for recovery and recycle of ammonium hydroxide if it is economically justified.

Drying and Calcining

Operating experience with the rotary equipment is limited but serious dust losses are not anticipated. Available rotoclones and scrubbers will be activated if necessary.

Operating Costs

Typical operating costs are given in the following tables. Table II gives the cost for ZrO_2 production in the month of January, 1951. Table III gives cost for ZrO_2 production total for the fiscal year July, 1950 through April, 1951.

These costs resulted from operation of the temporary zirconium production

facilities. Considerable economies in both labor and materials are expected from operation of the permanent zirconium plant. Estimated costs in report Y-573, p10, are expected to be in line with actual cost if allowance is made for general price advances.

TABLE IIUNIT COST OF ZRO₂ PRODUCTION, JANUARY, 1951

	Total Cost	Cost Per Pound Zr Produced
	<u>\$93,523</u>	<u>\$3.002</u>
Material		
Ammonium Hydroxide	1584	.051
Lime	133	.004
Hydrochloric Acid	1874	.061
Salicylic Acid	38934	1.251
Sulfuric Acid	658	.021
Ammonium Thiocyanate	10057	.323
ZrCl ₄	35165	1.129
Hexone	2186	.070
Natural Gas	693	.022
Steam	1534	.049
Treated Water	536	.017
Electricity	134	.004
Operating Labor, Direct	13,667	.439
Maintenance, Labor, & Material	15,763	.506
Allocated Plant Expense	12,455	.400
Analytical	3,740	.120
Miscellaneous *	9,128	.293
Total	<u>\$148,276</u>	<u>\$4.761</u>

Pounds Zirconium as Oxide Produced - 31,134

* Protective Clothing, Shipping Charges, Janitorial Services, Etc.

TABLE III

UNIT COST ZrO₂ PRODUCTION FROM JULY, 1950 THRU
APRIL, 1951

Material	<u>Total Cost</u>	<u>Cost/lb.</u>
	<u>\$731,971</u>	<u>\$2.943</u>
Ammonium Hydroxide	\$13,041	.052
Lime	1,710	.007
Hydrochloric Acid	22,408	.090
Salicylic Acid	278,764	1.121
Sulfuric Acid	3,679	.015
Ammonium Thiocyanate	89,211	.359
ZrCl ₄	287,050	1.154
Hexone	14,985	.060
Caustic Flake	41.	.000
Natural Gas	5,807	.023
Steam	10,821	.044
Treated Water	3,280	.013
Electricity	1,174	.005
Operating Labor	110,385	.443
Maintenance, Labor, & Material	148,453	.596
Allocated Plant Expense	124,067	.498
Analytical	33,471	.135
Miscellaneous	88,920	.357
Total	<u>\$1,237,267</u>	<u>\$4.972</u>

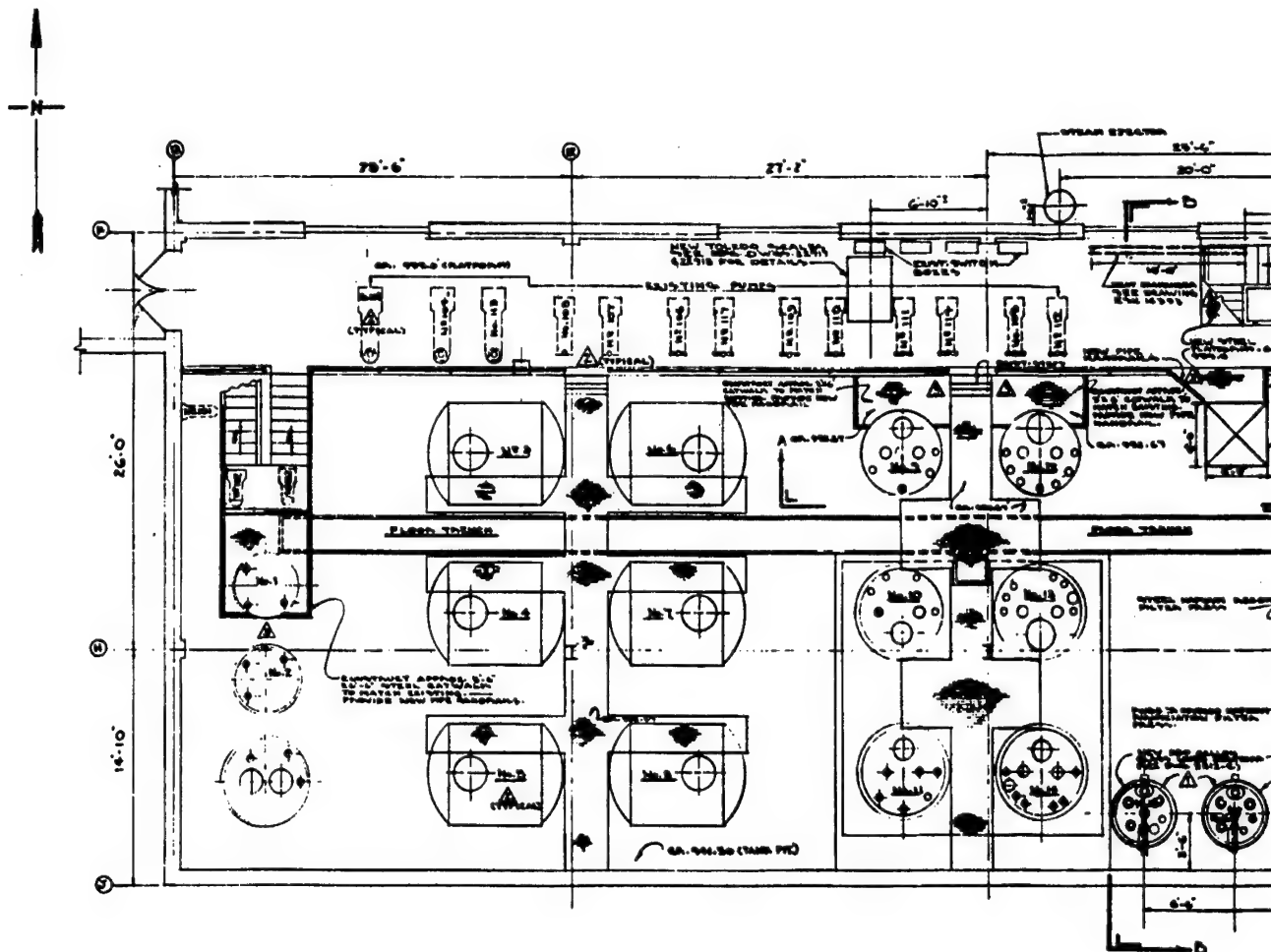
Pounds Zirconium as Oxide Produced - 248,751

BIBLIOGRAPHY OF Y-12 LITERATURE BEARING ON PRODUCTION OF ZIRCONIUM MATERIALS

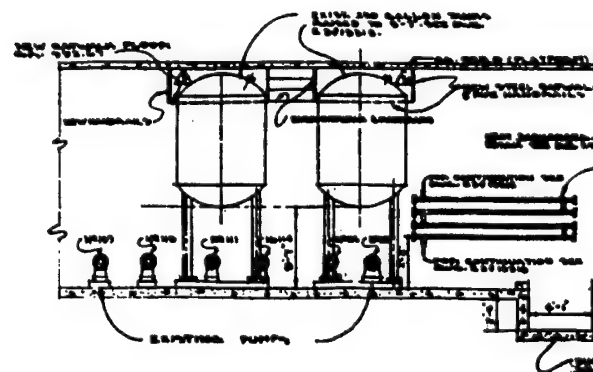
Bibliographies of Y-12 reports and reports of the MIT Practice School (Y-B4-43 and Y-B4-44) have been prepared by Mrs. Frances Sachs of the Y-12 Technical Information Center. Reports listed in these bibliographies contain important background material regarding the present processes for extraction, purification, and chlorination of zirconium materials at Y-12.

CONSTRUCTION DRAWINGS

Reduced drawings are given of principal engineering designs used in construction of the permanent zirconium plant. Drawings were prepared by Mr. F. S. Patton of the Engineering Department at Y-12 and were used as the basis of field instruction to construction personnel.

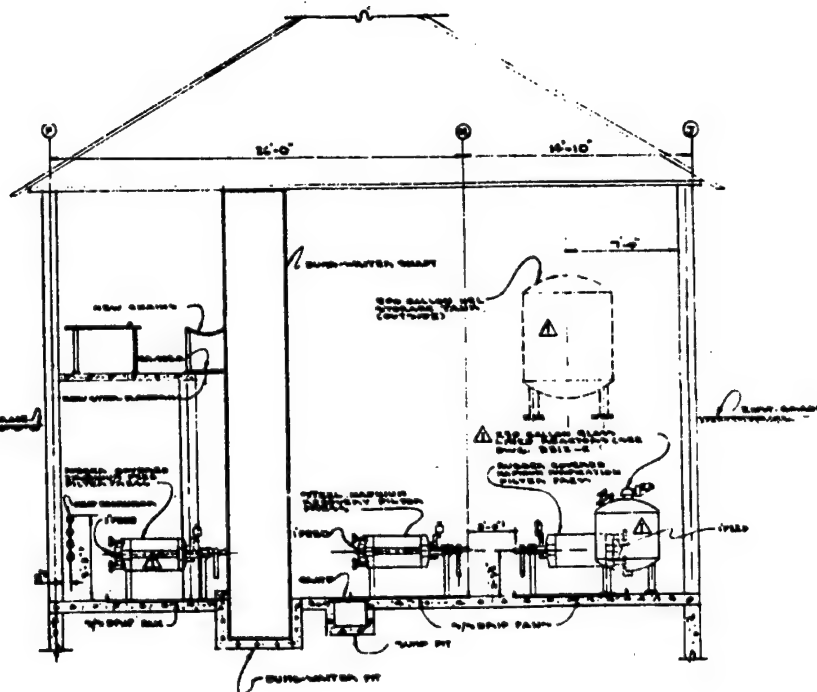
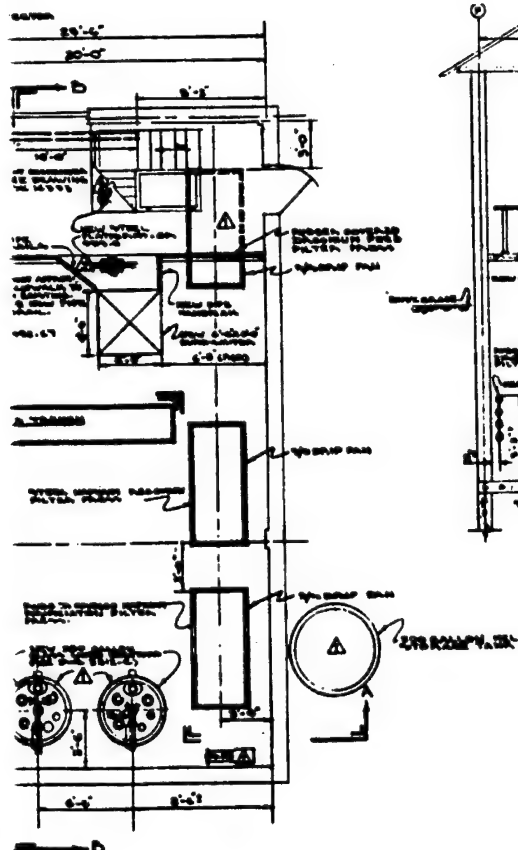


TANK FARM PLAN



ELEVATION-AA

PERMANENT ZIRCONIUM PLANT EQUIPMENT LOCA



ELEVATION-BB

TANK SCHEDULE

1. 6.7 E8 ———— PHTHALATE STORAGE
 2. ————— NH_4OH
 3. ————— FEED STORAGE
 4. 4 ————— PRODUCT STORAGE
 5. 12.12.913 ——— FEED HANDLING AREA
 11.14.91316 ——— MAGNUM

REF. DW'GS.

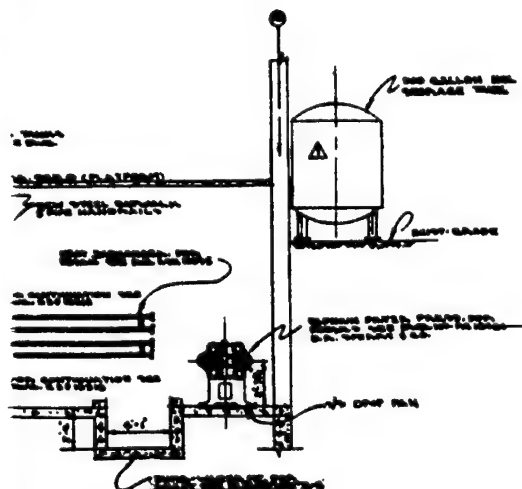
- 249 1956-----PERMANENT ZIRCONIUM PLANT
 FEED MAKEUP AREA-----PILOT DIAGRAM.
 240 1949-----PERMANENT ZIRCONIUM PLANT.
 FEED MAKEUP AREA-----PILOT DIAGRAM.
 248 1959-----PERMANENT ZIRCONIUM PLANT.
 FEED MAKEUP AREA-----HEAT EXCHANGER.
 246 1956-----PERMANENT ZIRCONIUM PLANT.
 FEED MAKEUP AREA-----GASOIL SHUTT OFFTER.
 244 1955-----PERMANENT ZIRCONIUM PLANT.
 FEED MAKEUP AREA-----GASOIL SHUTT OFFTER.
 242 1957-----PERMANENT ZIRCONIUM PLANT
 FEED MAKEUP AREA-----GASOIL SHUTT OFFTER
 241 1956-----TYPE 2-A. FILTER PRESS. D.O.
 WHEATY & CO.
 2312-2-----100 GALLON REACTOR-GLAN
 COTE FLOCCUTN, INC.
 2297-----PIT LAYOUT-----TYPE 9900-TOLEDO
 MEALS
 2278-----FRAME DETAILS-----TYPE 9900
 TOLEDO MEALS.

PJMP SCHEDULE

- P-104 DUEHLANDER MODEL 2200-60-11-10 P.
 P-102 PROPERTO HELL COMPLER 2200-60-11-10 P.
 P-103 DUEHLANDER MODEL 2200-60-11-10 P.
 P-104 DUEHLANDER MODEL 2200-60-11-10 P.
 P-105 DUEHLANDER MODEL 2200-60-11-10 P.
 P-106 DUEHLANDER MODEL 2200-60-11-10 P.
 P-107 DUEHLANDER MODEL 2200-60-11-10 P.
 P-108 DUEHLANDER MODEL 2200-60-11-10 P.
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 P-116 DUEHLANDER MODEL 2200-60-11-10 P.
 P-117 DUEHLANDER MODEL 2200-60-11-10 P.
 P-118 DUEHLANDER MODEL 2200-60-11-10 P.

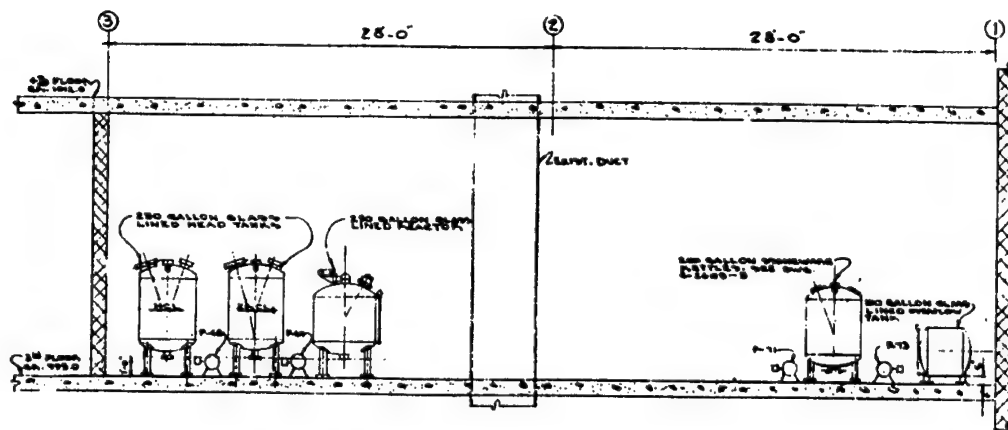
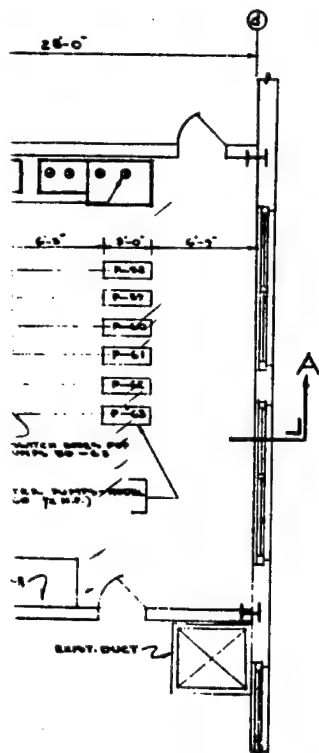
GEN. NOTES.

1. DIMENSIONS SHOWN MAY BE VARIED TO MEET FIELD CONDITIONS.
2. LIFTING EQUIPMENT SHOWN IN LIGHT LINES WHILE PAV. EQUIPMENT IN HEAVY.
3. FILTERS TO BE EQUIPPED WITH SUITABLE FINE CHIP PAVS. CONTRACTED IN FIELD.
4. FOR PLANS & PVT DETAILS OF TOLDO TRAP-SEE MANUFACTURER'S DWG. 22711 & 22712.
5. SEE LOCATION OF SCALE PVS DRAWING 216 10667.
6. DUNE WATER REMOVED FROM BLDG. 9201 & INSTALLED IN BUILDING 9211 & 9202. INSTRUCTIONS SEE BOTH IN US 269595.
7. SEE DRAWING TO FILL MAKEUP AREA SEE DWG. 216 10667, 10668 & 216 10669.

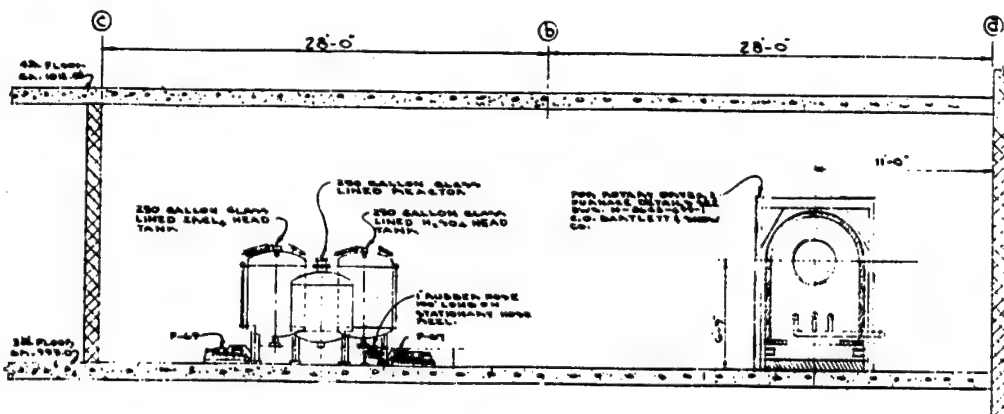
 ΔA

IPMENT LOCATION-FEED MAKEUP AREA, PLAN & ELEVATIONS

②



SECTION-B-B



SECTION-C-C

PUMP SCHEDULE

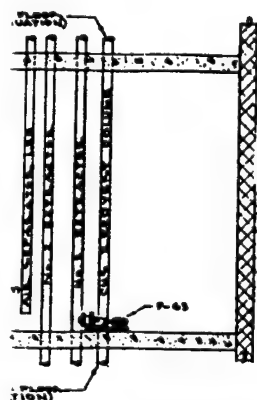
- P-60 - 250 GALLON GLASS-LINED HEAD TANK
 P-61 - MILTON ROY DUPLEX
 P-62 - MILTON ROY DUPLEX
 P-63 - MILTON ROY DUPLEX
 P-64 - MILTON ROY DUPLEX
 P-65 - MILTON ROY DUPLEX
 P-66 - MILTON ROY DUPLEX
 P-67 - MILTON ROY DUPLEX
 P-68 - MILTON ROY DUPLEX
 P-69 - MILTON ROY DUPLEX
 P-70 - MILTON ROY DUPLEX
 P-71 - MILTON ROY DUPLEX
 P-72 - MILTON ROY DUPLEX
 P-73 - MILTON ROY DUPLEX
 P-74 - MILTON ROY DUPLEX
 P-75 - MILTON ROY DUPLEX
 P-76 - MILTON ROY DUPLEX

REF. DWG'S

- E1019355 - PERMANENT ZIRCONIUM PLANT EQUIPMENT LOCATION - PURIFICATION & CALCING AREA - PLAN & SECTIONS
 E1019356 - PERMANENT ZIRCONIUM PLANT FLOW DIAGRAM - EXTRACTION COLUMN
 E1019487 - PERMANENT ZIRCONIUM PLANT PIPING LAYOUT - EXTRACTION CONTROL
 E1019510 - PERMANENT ZIRCONIUM PLANT EQUIPMENT DATA - 3RD FLOOR
 D-1019510 - PERMANENT ZIRCONIUM PLANT FILTER PRESS EXHAUST SYSTEM
 D-1019510 - PERMANENT ZIRCONIUM PLANT ONE LINE DIAGRAM - EXTRACTION CONTROL AREA
 H-1019510 - ROTARY DRYER - S.O. BARTLETT & SONS CO.
 H-1019510 - PERRY FILTER PRESS - D.E. PERRY & CO.
 C-1019510 - 250 GALLON STONE WARE KETTLE - GENERAL CERAMIC CO.
 B-1019510 - 250 GALLON GLASS LINED REACTOR - GLASSCO PRODUCTS
 G-1019510 - 250 GALLON EFFLUENT HEAD TANK - ALLOY FABRICATORS, INC.

GEN. NOTES

- ALL EQUIPMENT SHOWN ON 3RD FLOOR TO BE NEW EXCEPT AS NOTED.
- ALL TANK SUPPORTS TO BE DESIGNED AND INSTALLED BY THE FIELD.
- DIMENSIONS SHOWN ARE APPROXIMATE AND MAY BE VARIED TO MEET REQUIREMENTS.
- SEE MANUFACTURER'S DRAWINGS FOR DETAILS OF ROTARY DRYER, FILTER PRESS, 100 GALLON EFFLUENT KETTLE, GLASS LINED REACTOR, 250 GALLON HEAD TANK.
- NEW DRYER, FILTER PRESS, 100 GALLON EFFLUENT KETTLE, GLASS LINED REACTOR, 250 GALLON HEAD TANK TO BE LOCATED IN THE FIELD. LOCATION TO BE DETERMINED BY FIELD.
- ALL FILTERS TO BE EQUIPPED WITH EITHER STAINLESS STEEL OR HASTELLOY C-276. FIELD TO BE ADVISED OF ANY CHANGES IN FIELD EQUIPMENT.
- TITRATION TABLE TO BE FIELD (CONSTRUCTED BY FIELD).
- WATER BOILER FOR PUMP CO-76 TO BE LOCATED IN THE FIELD. LOCATION TO BE DETERMINED BY FIELD.
- PERMANENT GRAVITY FILTERS TO BE SPECIFIC GRAVITY FILTERS.
- ALL TANKS TO HAVE NIGHT CLIMBERS. USE OF NIGHT CLIMBERS TO BE DETERMINED UPON AVAILABLE OPENING.
- FOR FILTER PRESS EXHAUST SYSTEM SEE DWG. D-1019510.



PERMANENT ZIRCONIUM PLANT EXTRACTION CONTROL AREA EQUIPMENT LOCATION-PLAN & SECTION

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PIPE MARK SCHEDULE

- ① METELED H. 204 THRU P-66 TO TOP OF THE SULFUR SCRUBBER.
- ② ORGANIC PHASE FROM TOP OF THE SULFUR SCRUBBER TO HENRIE HEAD TANK.
- ③ METELED HCL THRU P-68 TO TOP OF THE H2 STRIPPER.
- ④ METELED OVERFLOW THRU P-75 TO TOP OF THE H2 STRIPPER.
- ⑤ METELED ZICCL THRU P-69 TO TOP OF H2 STRIPPER.
- ⑥ METELED HENRIE THRU P-71 TO BOTTOM OF THE CHS RECOVERY COLUMN (THE H2 EXTRACTOR).
- ⑦ ORGANIC PHASE FROM TOP OF H2 EXTRACTOR TO BOTTOM OF H2 STRIPPER.
- ⑧ AQUEOUS PHASE FROM BOTTOM OF THE H2 STRIPPER (THRU GRAVITY LEG & PUMPS 50-51) TO LINE 50 & TO THE TOP OF H2 EXTRACTOR.
- ⑨ ORGANIC PHASE FROM AIR SEPARATOR LEG OF H2 EXTRACTOR THRU PUMPS 50-51 TO THE BOTTOM OF H2 EXTRACTOR.
- ⑩ AQUEOUS PHASE FROM BOTTOM OF H2 EXTRACTOR (THRU GRAVITY LEG) TO TOP OF THE H2 STRIPPER.
- ⑪ AQUEOUS PHASE FROM BOTTOM OF H2 STRIPPER (THRU GRAVITY LEG) TO TOP OF THE H2 EXTRACTOR.
- ⑫ ORGANIC PHASE FROM TOP OF H2 EXTRACTOR TO BOTTOM OF H2 STRIPPER.
- ⑬ AQUEOUS PHASE FROM BOTTOM OF H2 STRIPPER (THRU GRAVITY LEG) TO TOP OF THE CHS RECOVERY COLUMN.
- ⑭ ORGANIC PHASE FROM AIR SEPARATOR LEG OF THE CHS RECOVERY COLUMN (THRU PUMPS 50-51) TO BOTTOM OF H2 EXTRACTOR.
- ⑮ ORGANIC PHASE FROM TOP OF H2 STRIPPER (THRU PUMPS 50-51) TO BOTTOM OF THE SULFURIC ACID SCRUBBER.
- ⑯ AQUEOUS PHASE FROM BOTTOM OF H2 STRIPPER (THRU GRAVITY LEG) TO TOP OF THE H2 EXTRACTOR.
- ⑰ ORGANIC PHASE FROM AIR SEPARATOR LEG OF H2 EXTRACTOR (THRU PUMPS 50-51) TO BOTTOM OF H2 STRIPPER.
- ⑱ OVERFLOW FROM ALL EXTRACTION COLUMNS AND GRAVITY LEGS TO THE OVERFLOW TANK ON 3RD FLOOR.
- ⑲ ZICCL FROM BOTTOM OF THE CHS RECOVERY COLUMN (THRU GRAVITY LEG & PUMPS 50-51) TO FEED MAKEUP AREA IN THE TANK FARM ON THE PURIFICATION AREA ON THE 2ND FLOOR.
- ① HENRIE FROM BOTTOM OF THE SULFURIC SCRUBBER (THRU GRAVITY LEG) TO FEED MAKEUP AREA IN THE TANK FARM.

GENERAL NOTES

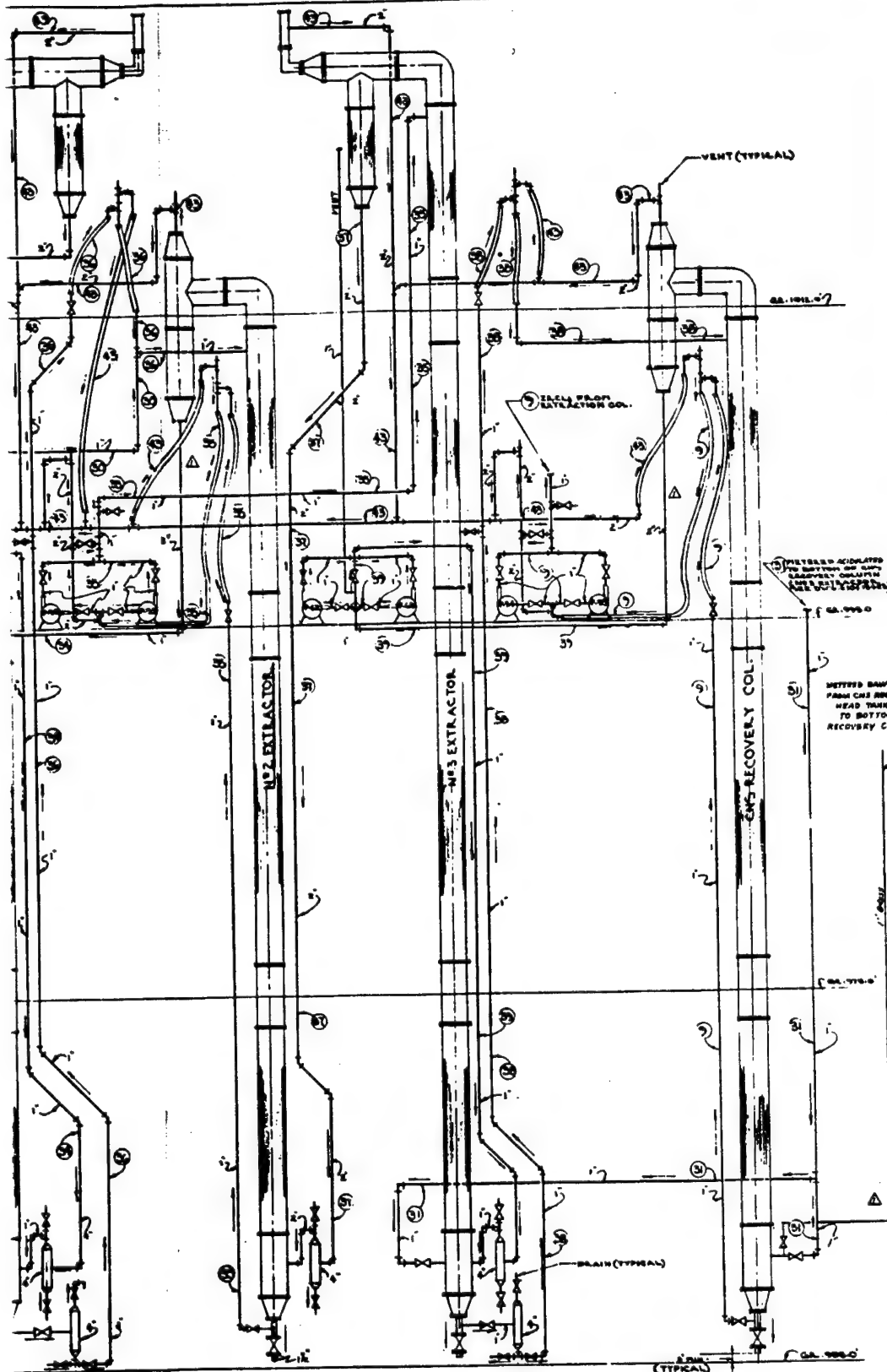
- 1- ALL PIPING SHOWN DIAGNOMATICALLY ONLY.
- 2- ALL PIPING TO BE PYREX GLASS LINED.
- 3- ALL VALVES TO BE MILLS-MECANNA GLASS LINED VALVES.
- 4- ALL MILLS-MECANNA GLASS LINED VALVES ON THE 1ST FLOOR TO BE NICKEL-PLATED.
- 5- USE D-25 GASKETS ON ALL GLASS LINES.
- 6- USE 247 WELDING ROD WHEN WELDING AN IRON TO GLASS JOINT. IN THE CONNECTION OF COLUMN SUPPORTS.
- 7- ELEVATION OF OVERFLOW LINE ON 3RD FLOOR TO BE 1500' MATCH OF ELEVATION LINE TO OVERFLOW TANK (SEE DWG. 1011345).
- 8- PUMPS 50-51 TO BE DUKICHOR 2-2110-60 (1.1M) BOOSTER PUMPS. FOR LOCATION OF PUMPS SEE DWG. 1011345.
- 9- FOR CONTINUATION OF LINES (1), 3, 26, 27, 28, 29, 30 & 31 SEE DWG. 1011351B, 1011351C, 1011351D, 1011351E & 1011351F.
- 10- ALL COLUMNS TO BE 4" PYREX GLASS PIPE EXCEPT FOR ONE (1) 12" SECTION OF 6" GLASS PIPE 1" ABOVE SPECIAL JOINTING ALL AT THE TOPS OF ALL COLUMNS.

REF. D.W.G.'S.

- 1011351B - PERMANENT ZIRCONIUM PLANT PIPING LAYOUT - FEED MAKEUP AREA.
- 1011351C - PERMANENT ZIRCONIUM PLANT PIPING LAYOUT - PURIFICATION AREA.
- 1011351D - PERMANENT ZIRCONIUM PLANT PIPING LAYOUT - EXTRACTION CONTROL AREA.
- 1011351E - PERMANENT ZIRCONIUM PLANT GENERAL PIPING LAYOUT.

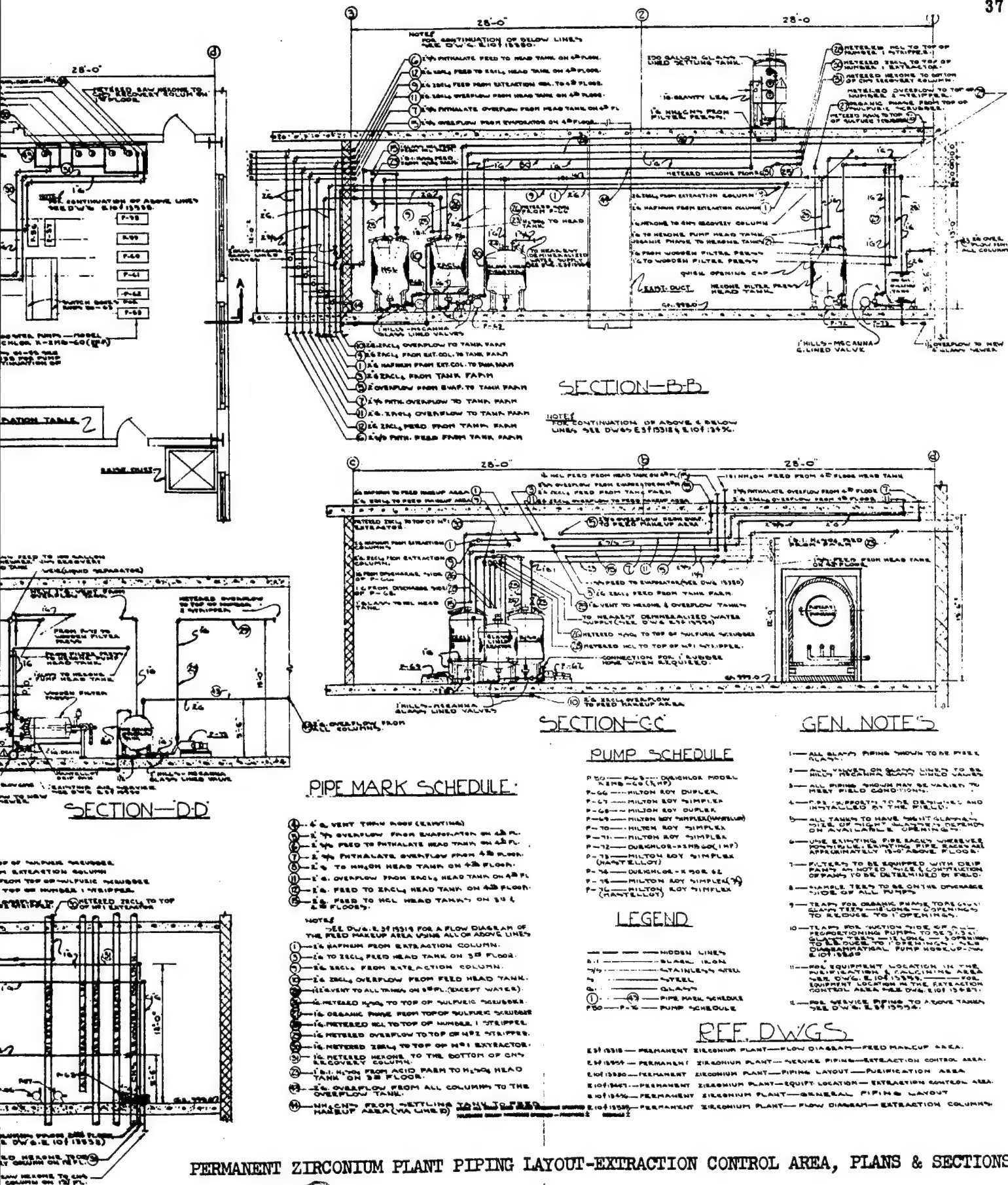
LEGEND

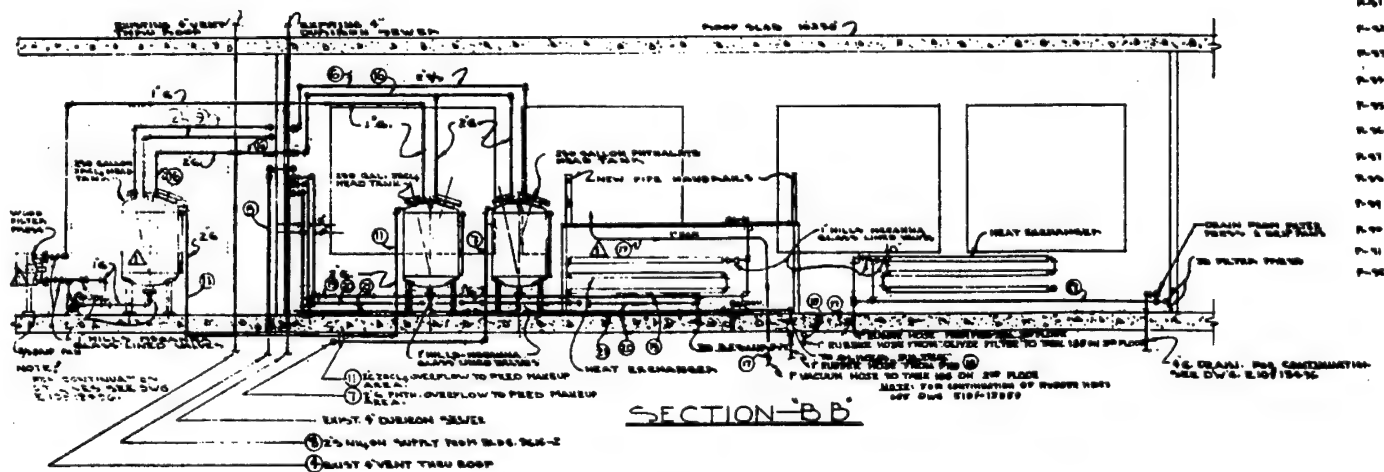
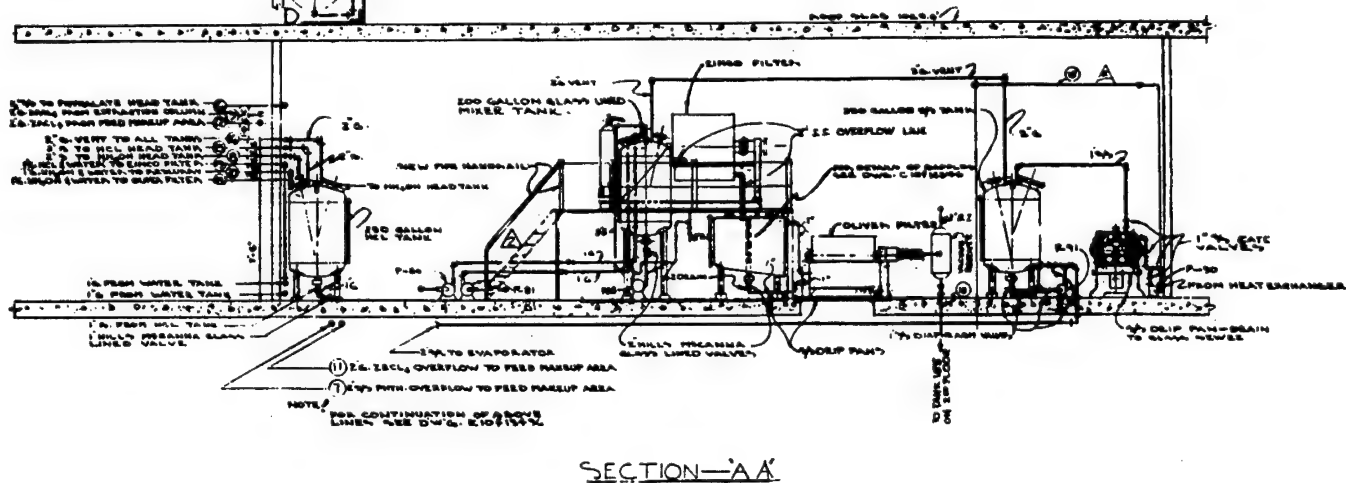
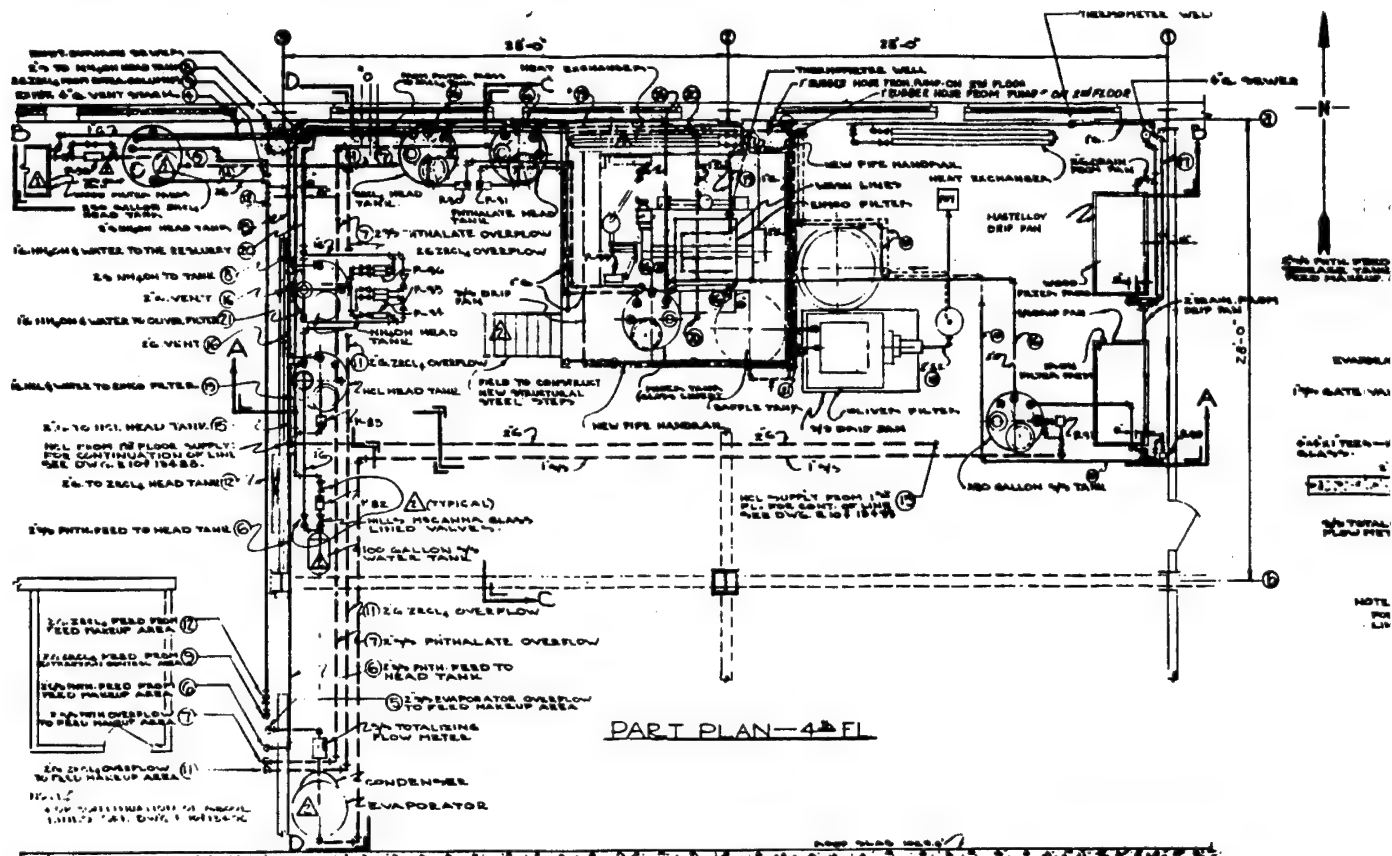
- ①, ②, ③, ④, ⑤ - PIPE MARK SCHEDULE
- ⑥ - DUKICHOR 2-2110-60 (1.1M) BOOSTER PUMP
- ⑦ - RUBBER GRAVITY LEGS

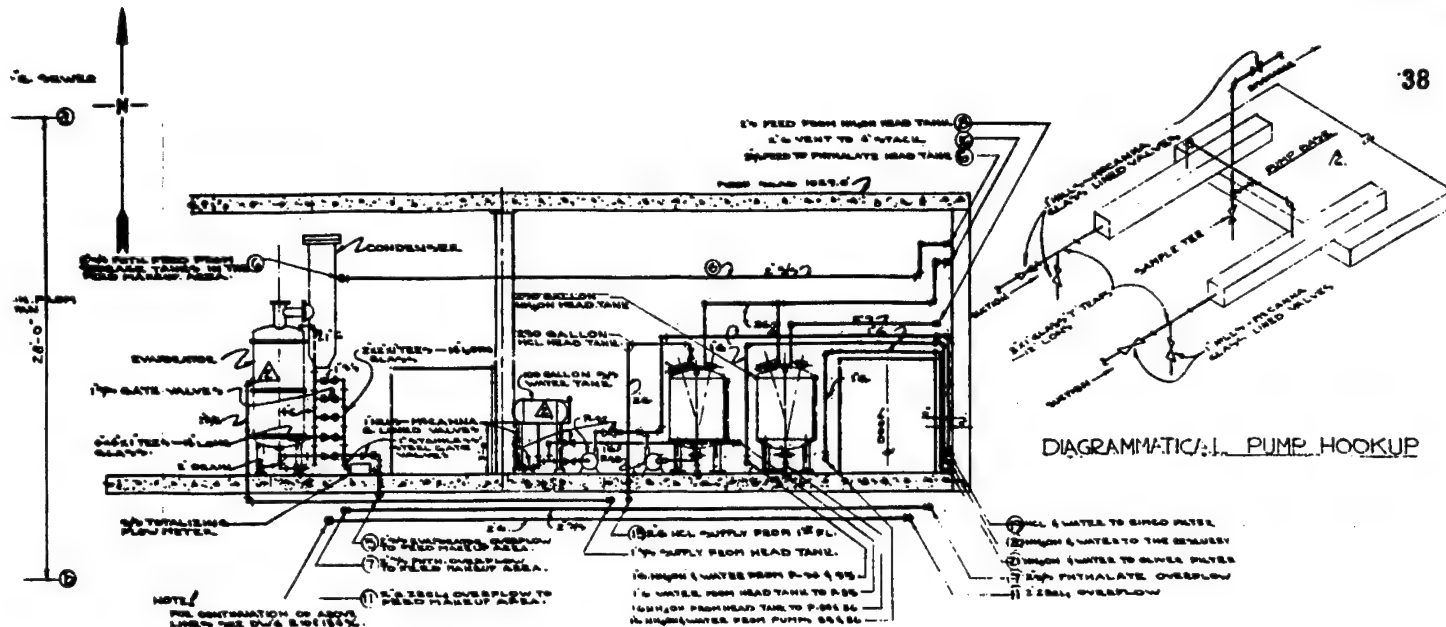


PERMANENT ZIRCONIUM PLANT FLOW DIAGRAM EXTRACTION COLUMNS

②







SECTION-DD

LEGEND

- 1/2" — STAINLESS STEEL
- 2" — STEEL
- 2" — PYREX GLASS PIPE
- 2" — BLACK IRON
- FLEXIBLE RUBBER HOSE
- P-30, P-32 PUMP NUMBERING (SEE PUMP SCHEDULE)
- ④ — ② PIPE NUMBERING (SEE PIPE MARK SCHEDULE)
- MIDDLE LINES (UNDER FLOOR OR PLATFORM)

REF. DWG'S

- E 101554 — PERMANENT ZIRCONIUM PLANT — EQUIPMENT LAYOUT — PURIFICATION CALCINING AREA.
- E 101546 — PERMANENT ZIRCONIUM PLANT — GENERAL LAYOUT
- E 101548 — PERMANENT ZIRCONIUM PLANT — PIPING LAYOUT — EXTRACTION CONTROL AREA.

SECTION-CC

PIPE MARK SCHEDULE

- ① 2" INCL. FROM EXTRACTION COLUMN
- ② 2" VENT FROM 1" INCL. TO EXHAUST CHIMNEY
- ③ 1" INCL. FROM EVAPORATOR ON 4th FLOOR.
- ④ 2" INCL. FEED TO PHTHALATE HEAD TANK ON 4th FLOOR.
- ⑤ 1" INCL. PHTHALATE OVERFLOW FROM 4th FLOOR.
- ⑥ 1" INCL. FEED TO NH₄OH HEAD TANK ON 4th FLOOR.
- ⑦ 1" INCL. OVERFLOW FROM 2" INCL. HEAD TANK ON 4th FLOOR.
- ⑧ 1" INCL. FEED TO 2" INCL. HEAD TANK ON 4th FLOOR.
- NOTE: SEE DWG. E 101554 FOR A FLOW DIAGRAM OF THE FEED MAKEUP AREA USING ALL OF THE ABOVE LINES.
- ⑨ 1" INCL. FEED TO HCL HEAD TANK ON 4th FLOOR.
- ⑩ 1" INCL. VENT TO ALL TANKS (EXCEPT WATER).
- ⑪ 1" INCL. FROM PT TO HEAT EXCHANGER (WOODEN FRAME).
- ⑫ 1" INCL. FROM OLIVEN FILTER TO IRON FILTER PRESS.
- ⑬ 1" INCL. HCL & WATER TO RIMED FILTER.
- ⑭ 1" INCL. NH₄OH & WATER TO THE PERMANENT.
- ⑮ 1" INCL. NH₄OH & WATER TO THE OLIVEN FILTER.

PUMP SCHEDULE

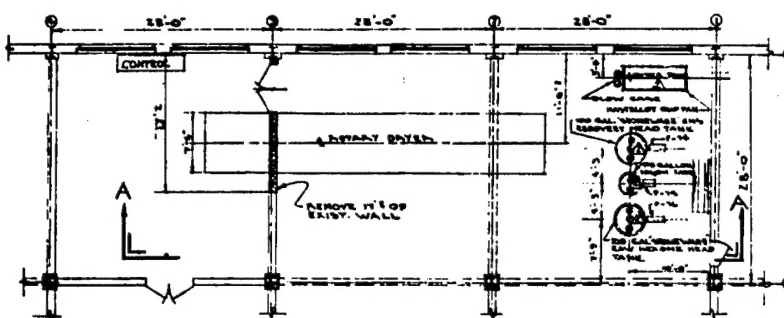
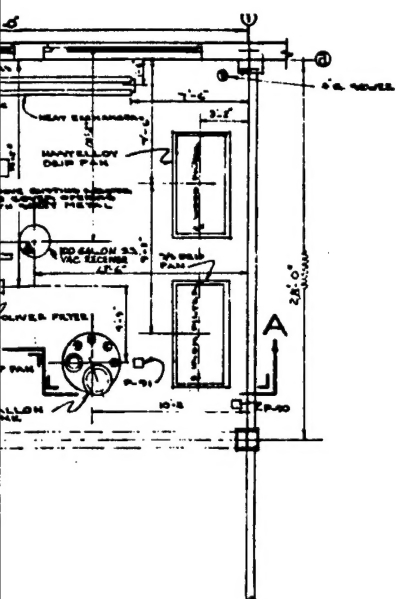
PUMP	MATERIAL
P-30 — FILTER BOY DUPLEX	STAINLESS STEEL
P-31 — FILTER BOY DUPLEX	STAINLESS STEEL
P-32 — FILTER BOY DUPLEX	STAINLESS STEEL
P-33 — FILTER BOY DUPLEX	STAINLESS STEEL
P-34 — FILTER BOY DUPLEX	STAINLESS STEEL
P-35 — FILTER BOY DUPLEX	STAINLESS STEEL
P-36 — FILTER BOY DUPLEX	STAINLESS STEEL
P-37 — FILTER BOY DUPLEX	STAINLESS STEEL
P-38 — FILTER BOY DUPLEX	STAINLESS STEEL
P-39 — FILTER BOY DUPLEX	STAINLESS STEEL
P-40 — FILTER BOY DUPLEX	STAINLESS STEEL
P-41 — FILTER BOY DUPLEX	STAINLESS STEEL
P-42 — FILTER BOY DUPLEX	STAINLESS STEEL
P-43 — FILTER BOY DUPLEX	STAINLESS STEEL
P-44 — FILTER BOY DUPLEX	STAINLESS STEEL
P-45 — FILTER BOY DUPLEX	STAINLESS STEEL
P-46 — FILTER BOY DUPLEX	STAINLESS STEEL
P-47 — FILTER BOY DUPLEX	STAINLESS STEEL
P-48 — FILTER BOY DUPLEX	STAINLESS STEEL
P-49 — FILTER BOY DUPLEX	STAINLESS STEEL
P-50 — FILTER BOY DUPLEX	STAINLESS STEEL
P-51 — FILTER BOY DUPLEX	STAINLESS STEEL
P-52 — FILTER BOY DUPLEX	STAINLESS STEEL
P-53 — FILTER BOY DUPLEX	STAINLESS STEEL
P-54 — FILTER BOY DUPLEX	STAINLESS STEEL
P-55 — FILTER BOY DUPLEX	STAINLESS STEEL
P-56 — FILTER BOY DUPLEX	STAINLESS STEEL
P-57 — FILTER BOY DUPLEX	STAINLESS STEEL
P-58 — FILTER BOY DUPLEX	STAINLESS STEEL
P-59 — FILTER BOY DUPLEX	STAINLESS STEEL
P-60 — FILTER BOY DUPLEX	STAINLESS STEEL
P-61 — FILTER BOY DUPLEX	STAINLESS STEEL
P-62 — FILTER BOY DUPLEX	STAINLESS STEEL
P-63 — FILTER BOY DUPLEX	STAINLESS STEEL
P-64 — FILTER BOY DUPLEX	STAINLESS STEEL
P-65 — FILTER BOY DUPLEX	STAINLESS STEEL
P-66 — FILTER BOY DUPLEX	STAINLESS STEEL
P-67 — FILTER BOY DUPLEX	STAINLESS STEEL
P-68 — FILTER BOY DUPLEX	STAINLESS STEEL
P-69 — FILTER BOY DUPLEX	STAINLESS STEEL
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P-77 — FILTER BOY DUPLEX	STAINLESS STEEL
P-78 — FILTER BOY DUPLEX	STAINLESS STEEL
P-79 — FILTER BOY DUPLEX	STAINLESS STEEL
P-80 — FILTER BOY DUPLEX	STAINLESS STEEL
P-81 — FILTER BOY DUPLEX	STAINLESS STEEL
P-82 — FILTER BOY DUPLEX	STAINLESS STEEL
P-83 — FILTER BOY DUPLEX	STAINLESS STEEL
P-84 — FILTER BOY DUPLEX	STAINLESS STEEL
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P-88 — FILTER BOY DUPLEX	STAINLESS STEEL
P-89 — FILTER BOY DUPLEX	STAINLESS STEEL
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P-95 — FILTER BOY DUPLEX	STAINLESS STEEL
P-96 — FILTER BOY DUPLEX	STAINLESS STEEL
P-97 — FILTER BOY DUPLEX	STAINLESS STEEL
P-98 — FILTER BOY DUPLEX	STAINLESS STEEL
P-99 — FILTER BOY DUPLEX	STAINLESS STEEL
P-100 — FILTER BOY DUPLEX	STAINLESS STEEL

GEN. NOTES

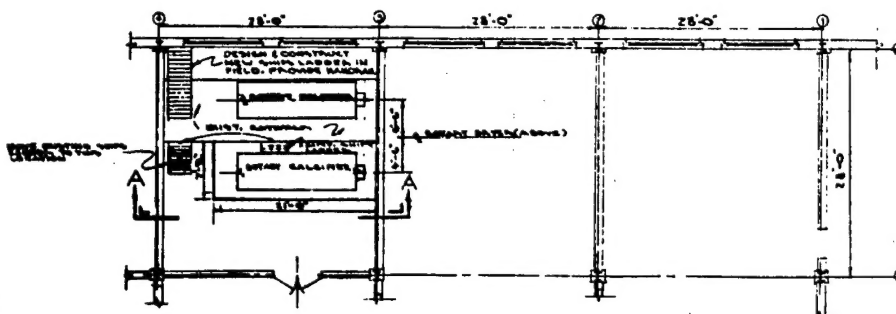
- 1. ALL GLASS PIPING SHOWN TO BE PYREX GLASS.
- 2. ALL VALVES ON GLASS LINES TO BE WELD, MS, CANNA GLASS LINED VALVES, EXCEPT WHERE NOTED.
- 3. USE WELD, MS, CANNA GLASS LINED VALVES ON STEEL OR BLACK IRON LINES.
- 4. PIPING SHOWN DIAGRAMMATICALLY ONLY AND MAY BE VARIED TO MEET FIELD CONDITIONS.
- 5. PIPE SUPPORTS TO BE DESIGNED AND INSTALLED BY THE FIELD.
- 6. GLASS PIPE MAY BE SUBSTITUTED FOR WOOD OR STEEL PIPES WHEREVER IT IS MORE EXPEDIENT.
- 7. PIPING HOOKUP FOR WOOD FILTER PRESS TO BE THE SAME AS SHOWN FOR IRON FILTER PRESS.
- 8. ALL FILTER PRESSSES TO BE EQUIPPED WITH OUP PUMP, AS NOTED. OUP PUMP TO BE USED AS CONTINGENCY IN THE FIELD.
- 9. FOR EQUIPMENT LOCATION IN THE PURIFICATION & CALCINING AREA, SEE DWG. E 101554.
- 10. DIAGRAMMATIC PUMP HOOKUP TO APPLY TO ALL FILTER BOY DUPLEX PUMPS.

PERMANENT ZIRCONIUM PLANT PIPING LAYOUT-PURIFICATION AREA, PLAN & SECTIONS

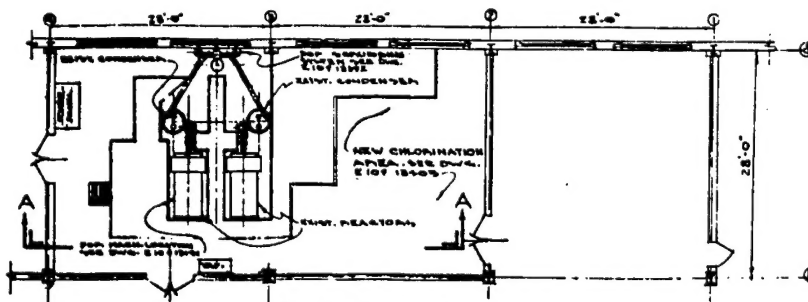
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PART PLAN-3RD FL
SCALE 1/8"=1'-0"



PART PLAN-2ND FL
SCALE 1/8"=1'-0"



PART PLAN-1ST FL
SCALE 1/8"=1'-0"

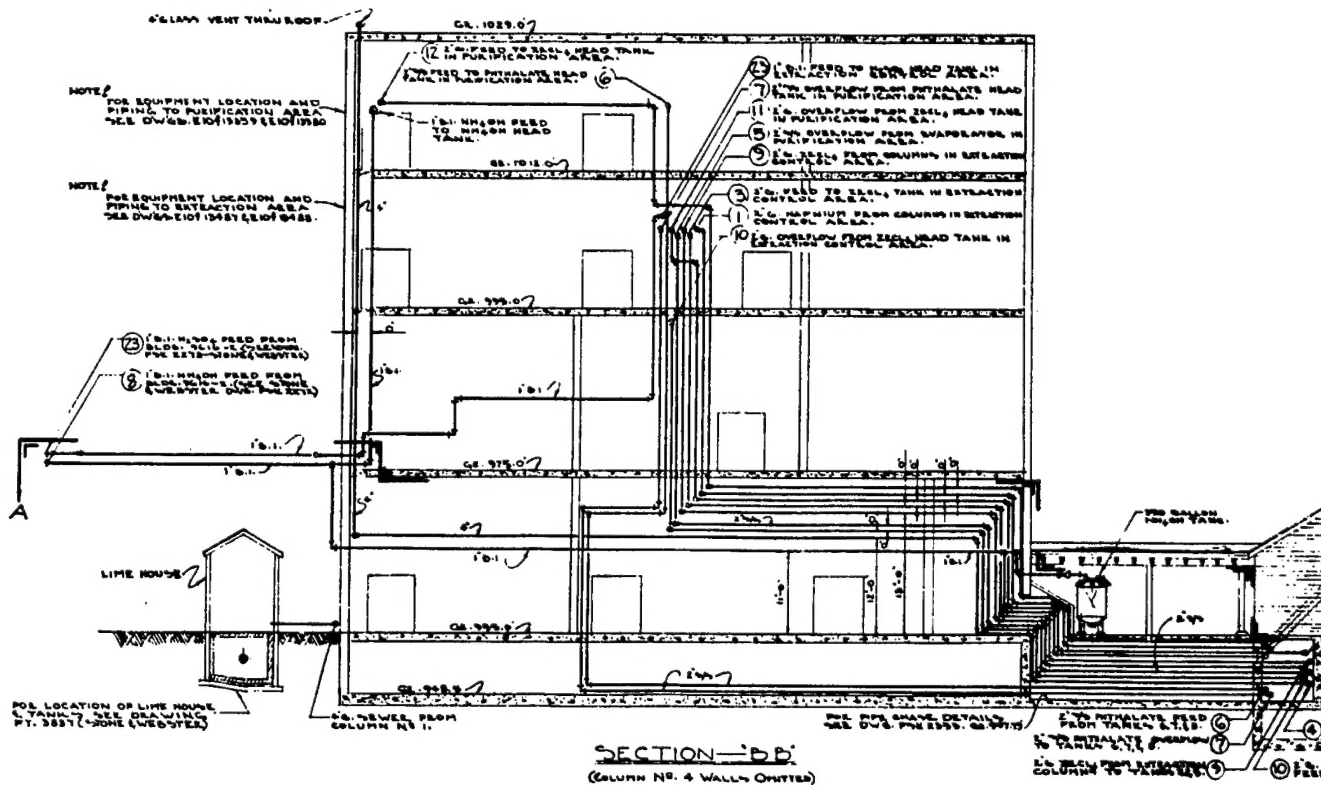
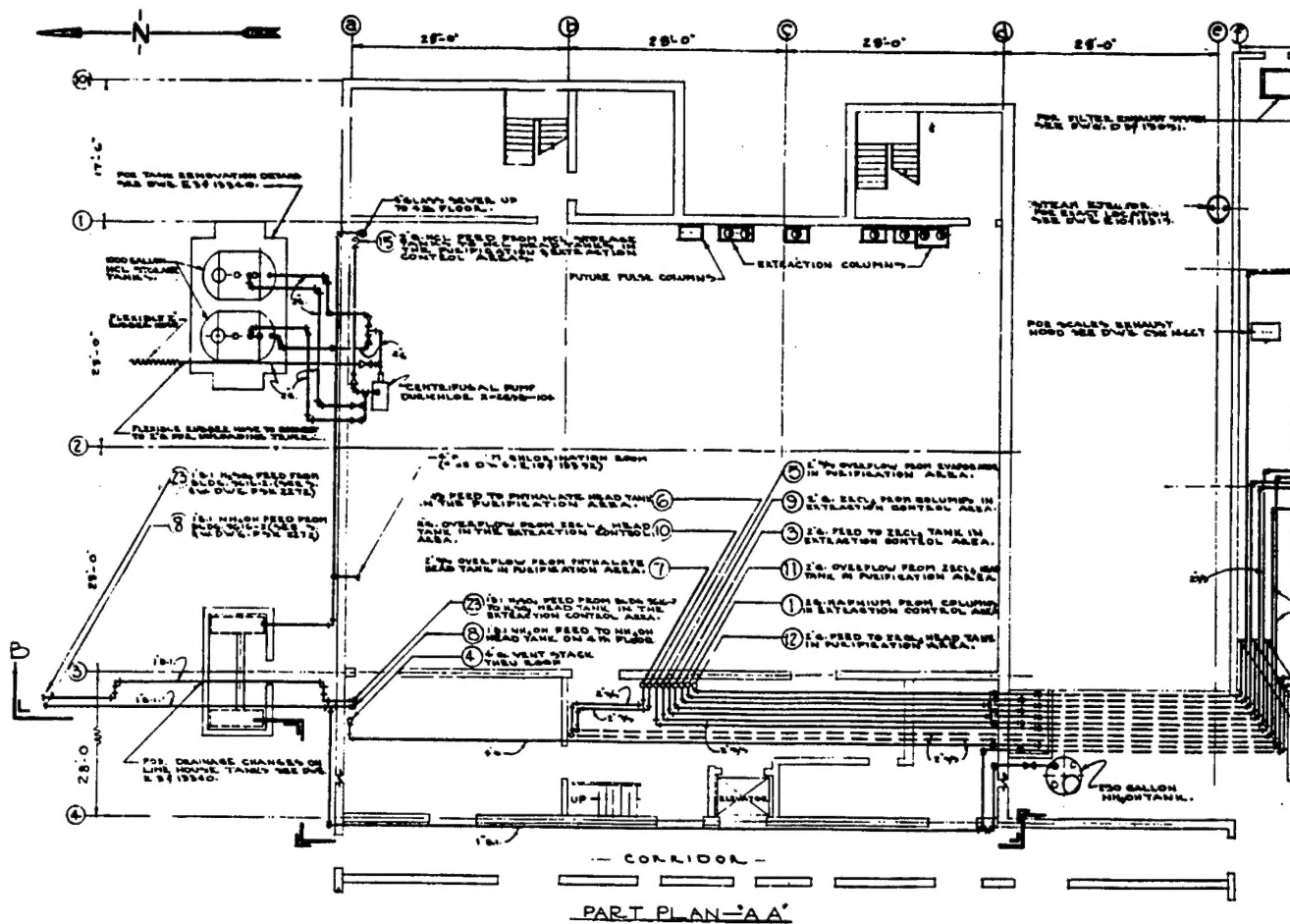
REF. DWGS.

- E 1015410 — PERMANENT ZIRCONIUM PLANT — EQUIPMENT
- E 1015411 — PERMANENT ZIRCONIUM PLANT — EXHAUSTION CONTROL AREA
- E 1015412 — PERMANENT ZIRCONIUM PLANT — EXHAUSTION CONTROL AREA
- E 1015413 — PERMANENT ZIRCONIUM PLANT — EXHAUSTION CONTROL AREA
- E 1015414 — PERMANENT ZIRCONIUM PLANT — EXHAUSTION CONTROL AREA
- E 1015415 — PERMANENT ZIRCONIUM PLANT — EXHAUSTION CONTROL AREA
- E 1015416 — PERMANENT ZIRCONIUM PLANT — EXHAUSTION CONTROL AREA
- E 1015417 — PERMANENT ZIRCONIUM PLANT — EXHAUSTION CONTROL AREA
- E 1015418 — PERMANENT ZIRCONIUM PLANT — EXHAUSTION CONTROL AREA
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- E 1015465 — PERMANENT ZIRCONIUM PLANT — EXHAUSTION CONTROL AREA
- E 1015466 — PERMANENT ZIRCONIUM PLANT — EXHAUSTION CONTROL AREA
- E 1015467 — PERMANENT ZIRCONIUM PLANT — EXHAUSTION CONTROL AREA
- E 1015468 — PERMANENT ZIRCONIUM PLANT — EXHAUSTION CONTROL AREA
- E 1015469 — PERMANENT ZIRCONIUM PLANT — EXHAUSTION CONTROL AREA
- E 1015470 — PERMANENT ZIRCONIUM PLANT — EXHAUSTION CONTROL AREA
- E 1015471 — PERMANENT ZIRCONIUM PLANT — EXHAUSTION CONTROL AREA
- E 1015472 — PERMANENT ZIRCONIUM PLANT — EXHAUSTION CONTROL AREA
- E 1015473 — PERMANENT ZIRCONIUM PLANT — EXHAUSTION CONTROL AREA
- E 1015474 — PERMANENT ZIRCONIUM PLANT — EXHAUSTION CONTROL AREA
- E 1015475 — PERMANENT ZIRCONIUM PLANT — EXHAUSTION CONTROL AREA
- E 1015476 — PERMANENT ZIRCONIUM PLANT — EXHAUSTION CONTROL AREA
- E 1015477 — PERMANENT ZIRCONIUM PLANT — EXHAUSTION CONTROL AREA
- E 1015478 — PERMANENT ZIRCONIUM PLANT — EXHAUSTION CONTROL AREA
- E 1015479 — PERMANENT ZIRCONIUM PLANT — EXHAUSTION CONTROL AREA
- E 1015480 — PERMANENT ZIRCONIUM PLANT — EXHAUSTION CONTROL AREA
- E 1015481 — PERMANENT ZIRCONIUM PLANT — EXHAUSTION CONTROL AREA
- E 1015482 — PERMANENT ZIRCONIUM PLANT — EXHAUSTION CONTROL AREA
- E 1015483 — PERMANENT ZIRCONIUM PLANT — EXHAUSTION CONTROL AREA
- E 1015484 — PERMANENT ZIRCONIUM PLANT — EXHAUSTION CONTROL AREA
- E 1015485 — PERMANENT ZIRCONIUM PLANT — EXHAUSTION CONTROL AREA
- E 1015486 — PERMANENT ZIRCONIUM PLANT — EXHAUSTION CONTROL AREA
- E 1015487 — PERMANENT ZIRCONIUM PLANT — EXHAUSTION CONTROL AREA
- E 1015488 — PERMANENT ZIRCONIUM PLANT — EXHAUSTION CONTROL AREA
- E 1015489 — PERMANENT ZIRCONIUM PLANT — EXHAUSTION CONTROL AREA
- E 1015490 — PERMANENT ZIRCONIUM PLANT — EXHAUSTION CONTROL AREA
- E 1015491 — PERMANENT ZIRCONIUM PLANT — EXHAUSTION CONTROL AREA
- E 1015492 — PERMANENT ZIRCONIUM PLANT — EXHAUSTION CONTROL AREA
- E 1015493 — PERMANENT ZIRCONIUM PLANT — EXHAUSTION CONTROL AREA
- E 1015494 — PERMANENT ZIRCONIUM PLANT — EXHAUSTION CONTROL AREA
- E 1015495 — PERMANENT ZIRCONIUM PLANT — EXHAUSTION CONTROL AREA
- E 1015496 — PERMANENT ZIRCONIUM PLANT — EXHAUSTION CONTROL AREA
- E 1015497 — PERMANENT ZIRCONIUM PLANT — EXHAUSTION CONTROL AREA
- E 1015498 — PERMANENT ZIRCONIUM PLANT — EXHAUSTION CONTROL AREA
- E 1015499 — PERMANENT ZIRCONIUM PLANT — EXHAUSTION CONTROL AREA
- E 1015500 — PERMANENT ZIRCONIUM PLANT — EXHAUSTION CONTROL AREA

GEN. NOTES

- 1 — ALL EQUIPMENT AND CONSTRUCTION SHOWN ON 1ST, 2ND, 3RD, 4TH FLOORS TO BE NEW, EXCEPT NOTED.
- 2 — ALL EQUIPMENT SHOWN ON 1ST FLOOR IS EXISTING.
- 3 — ALL TANK SUPPORTS TO BE DESIGNED IN THE FIELD.
- 4 — DIMENSIONS SHOWN ARE APPROXIMATE AND MAY BE VARIED TO MEET FIELD CONDITIONS.
- 5 — SEE MANUFACTURER'S DRAWINGS FOR DETAILS OF ROTARY DRYER, ROTARY CALCIUM, SINTER OVER FILTERS, FILTER PRESS, ETC.
- 6 — DIMENSIONS OF 2'-10" x 10" TO BE LOCATED APPROX. WHERE SHOWN BUT EXACT LOCATION TO BE DETERMINED IN FIELD.
- 7 — PPA PUMP SCHEDULE SEE DWG. NO. E1015350.
- 8 — ALL FILTER PRESSES TO BE EQUIPPED WITH DRAIN PANS, AS NOTED. DRAIN PANS TO BE TIED AND COMPLETED IN THE FIELD.
- 9 — ALL TANKS TO BE EQUIPPED WITH NIGHT GLAZES, SIZE OF GLAZES WILL DEPEND ON SIZE OF TANK OPENINGS IN TANKS.

2



- 1-FOR SERVICE PIPING TO THE FEED MAKE
UP AREA, EXTRACTION CONTROL AREA, &
DIST. WING: E-311507, E-311509, E-311534.
- 2-FOR EQUIPMENT LOCATION TO THE FEED MAKE
UP AREA, EXTRACTION CONTROL AREA, &
DIST. WING: E-101517, E-101519, & E-101521.
- 3-FOR EXHAUST SYSTEM IN THE EXTRACTION
CONTROL AREA & PURIFICATION AREA THE
DWS: E-311590 & E-311596.
- 4-FOR REACTOR EXHAUST SYSTEM IN THE FEED
MAKE UP AREA THE DWS: E-311593.
- 5-FOR FILTER PANS, EXHAUST SYSTEM IN THE
EXTRACTION CONTROL AREA, PURIFICATION
AREA, & PURIFICATION AREA, RE-RENNING
DIST. WING, DWS: 16646 & DWS: 16670.
- 6-ALL PIPING SHOWN IN DIAGRAMMATIC PLAN FOR
THE FIELD.
- 7-ALL PIPING SHOWN TO BE FREE GLASS
EXCEPT WHERE NOTED.
- 8-PIPE SUPPORTS TO BE DESIGNED AND
INSTALLED BY THE FIELD.
- 9-FEED CONDUIT PLAN OF THE EXTRACTION
CONTROL AREA THE DWS: E-311590 &

- (1) 1" G. WASHFLO FROM COLUMNS IN EXTRACTION CONTROL AREA TO WASHFLO TANKS. 11.4 IN FRED MAKEUP AREA.
- (2) 1" G. ZCLCL FLOW FROM STORAGE TANKS IN FRED MAKEUP AREA TO ZCLCL HEAD TANK IN EXTRACTION CONTROL AREA.
- (3) 1" G. VENT FROM ALL TANKS IN THE FRED MAKEUP AREA TO NORTH WARD OF BLDG. 9211.1 THEN THRU SUMP WITH A 3" STACK.
- (4) 1" G. OVERFLOW FROM OVERFLOWERS IN PURIFICATION AREA TO PRODUCT STORAGE TANKS 7.1, 7.2 IN THE FRED MAKEUP AREA.
- (5) 1" G. PHYNALATE FLOW FROM PHYNALATE TANKS 7.1, 7.2 IN FRED MAKEUP AREA TO PHYNALATE HEAD TANK IN PURIFICATION AREA.
- (6) 1" W. OVERFLOW FROM PHYNALATE HEAD TANK IN PURIFICATION AREA TO PHYNALATE STORAGE TANKS 7.1, 7.2 IN FRED MAKEUP AREA.
- (7) 1" W. WASH FLOW FROM BLDG. 9211-2 TO WASH HEAD TANK IN THE FRED MAKEUP AREA (SEE 9211-2 W. 2.1, 2.2, 2.3)
- (8) 1" G. ZCLCL FLOW FROM COLUMNS IN EXTRACTION CONTROL AREA TO PRODUCT STORAGE TANKS 7.1, 7.2 IN FRED MAKEUP AREA.
- (9) 1" G. OVERFLOW FROM ZCLCL HEAD TANK IN EXTRACTION CONTROL AREA TO ZCLCL STORAGE TANKS 7.1, 7.2 IN FRED MAKEUP AREA.
- (10) 1" G. OVERFLOW FROM ZCLCL HEAD TANK IN PURIFICATION AREA TO PRODUCT STORAGE TANKS 7.1, 7.2 IN FRED MAKEUP AREA.
- (11) 1" G. ZCLCL FLOW FROM PRODUCT STORAGE TANKS 7.1, 7.2 IN FRED MAKEUP AREA TO ZCLCL HEAD TANK IN PURIFICATION AREA.
- (12) 1" G. HCL FLOW FROM HCL STORAGE TANKS ON THE NORTH SIDE OF BLDG. 9211 TO HCL HEAD TANKS IN THE PURIFICATION EXTRACTION CONTROL AREA.
- (13) 1" G. VENT TO ALL TANKS (EXCEPT WATER) IN THE PURIFICATION AREA.
- (14) 1" G. HCL FLOW FROM BLDG. 9211-2 TO HCL HEAD TANKS IN EXTRACTION CONTROL AREA (SEE 9211-2 W. 2.1, 2.2, 2.3)
- (15) 1" G. VENT TO ALL TANKS (EXCEPT WATER) IN THE EXTRACTION CONTROL AREA.

P#12333 - TANK FARM STORAGE PLATFORM -
 STONE & WEDGETE.
 P#12372 - VARD PIPING - BLOW 7211 - STONE
 AND WEDGETE.
 PT 3837 - PERMANENT ZIRCONIUM PLANT -
 PUMP HOUSE AND TAMPING TANKS.
 R#12440 - PERMANENT ZIRCONIUM PLANT -
 CONDUIT PLAN - EXTRACTION CONTROL AREA.
 R#12450 - PERMANENT ZIRCONIUM PLANT - FILTER
 PRESS EXHAUST SYSTEM - PURIFICATION AREA.
 R#12467 - PERMANENT ZIRCONIUM PLANT - SERVICE
 EXHAUST HOOD - FEED MAKEUP AREA.
 R#12488 - PERMANENT ZIRCONIUM PLANT - EXTRACTOR
 EXHAUST SYSTEM - FEED MAKEUP AREA.
 R#12489 - PERMANENT ZIRCONIUM PLANT - FEED
 EXHAUST SYSTEM - FEED MAKEUP AREA.
 R#12494 - PERMANENT ZIRCONIUM PLANT - FILTER
 PRESS EXHAUST SYSTEM - FEED MAKEUP AREA.
 R#12500 - PERMANENT ZIRCONIUM PLANT - FILTER
 PRESS EXHAUST SYSTEM - FEED MAKEUP AREA.
 R#12510 - PERMANENT ZIRCONIUM PLANT - EXHAUST
 SYSTEM - PURIFICATION AREA.
 R#12518 - PERMANENT ZIRCONIUM PLANT
 FLOW DIAGRAM - FEED MAKEUP AREA.
 R#12529 - PERMANENT ZIRCONIUM PLANT -
 EQUIPMENT LOCATION - FEED MAKEUP AREA.
 R#12530 - PERMANENT ZIRCONIUM PLANT - EQUIPT.
 LOCATION - PURIFICATION & GASOLINE AREA.
 R#12530 - PERMANENT ZIRCONIUM PLANT
 PIPING LAYOUT - PURIFICATION AREA.
 R#12541 - PERMANENT ZIRCONIUM PLANT - EQUIPT.
 LOCATION - EXTRACTION AREA.
 R#12548 - PERMANENT ZIRCONIUM PLANT - PIPING
 LAYOUT - EXTRACTION CONTROL AREA.
 R#12550 - PERMANENT ZIRCONIUM PLANT - FLOW
 DIAGRAM - EXTRACTION COLUMNS.
 R#12550 - PERMANENT ZIRCONIUM PLANT - SERVICE
 LINES - EXTRACTION CONTROL AREA.
 R#12574 - PERMANENT ZIRCONIUM PLANT - SERVICE
 LINES - PURIFICATION AREA.
 R#12587 - PERMANENT ZIRCONIUM PLANT - DEHUMIDIFIED
 WATER - FEED MAKEUP AREA.
 R#12590 - PERMANENT ZIRCONIUM PLANT - CONTACT
 TANK. RENOVATION - BLOW 7510-6.
 R#12595 - PERMANENT ZIRCONIUM PLANT -
 CHLORINATION - SCRUBBING SYSTEM.
 R#12595 - PERMANENT ZIRCONIUM PLANT -
 ONE LINE DIAGRAM - EXTRACTION CONTROL AREA.

1,6,7,8 ———— PHTHALATE STORAGE
2 ———— NH₄OH
3 ———— FEED STORAGE
4,5 ———— PRODUCT STORAGE
9,10,12,13 ———— FEED MAKEUP
11,14,15,16 ———— NAFIUM

① — ② — PIPE NUMBERING (SEE
PIPE RACK HEADS)

— — — HIDDEN LINES

5.1. — — — BLACK IRON

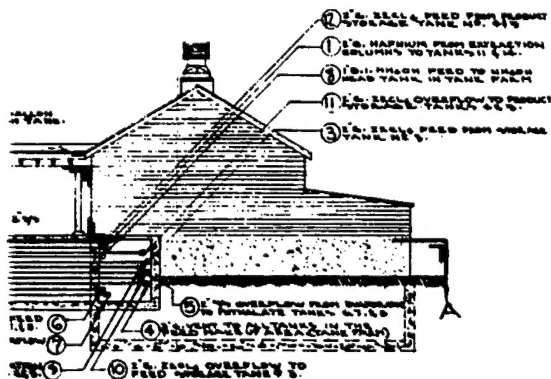
7/8 — — — STAINLESS STEEL

3 — — — STEEL

WARRANT — — FLEXIBLE RUBBER HOSE

6. — — — GLASS

③ — — — EXTRACTION COLUMNS



PERMANENT ZIRCONIUM PLANT, GENERAL PIPING LAYOUT

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ACKNOWLEDGEMENTS

The authors wish to acknowledge contributions and express gratitude for assistance in preparation of report materials from Mr. F. S. Patton of the Engineering Department, Mr. J. M. Googin of the Chemical Division Staff, Mrs. Jane Uffelman of the Y-12 Technical Information Center, and Mr. J. W. Ebert of the Chemical Department.